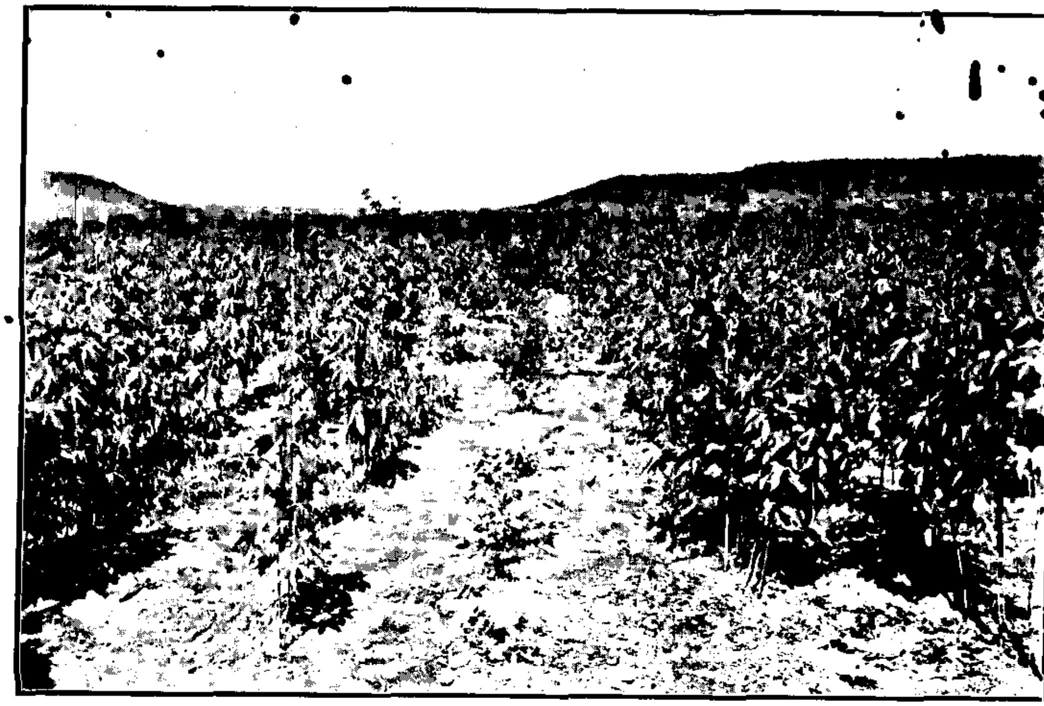

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II.

Photo.-Mechl. Depts, Thomason College, Roorkee.

Photos. by C. G. Rogers.

The raising of forests with field crops in Berar.

VOLUME XXXVII NUMBER 1 & 2

# INDIAN FORESTER

*JANUARY & FEBRUARY, 1911.*

## PAPER AND PAPER-PULP INDUSTRY IN INDIA.*

BY WILLIAM RAITT,

*Paper Fibre Expert, Forestry Court, U. P. Exhibition, Allahabad.*

Few people realise the extent to which the use of paper has become one of the necessities of modern civilisation. We use it in extremely small amounts at a time: it is so cheap that its cost does not impress us with any idea as to quantity: we neglect the cumulative result of using it,—and wasting it, every day, and some of us all day, we seldom or never have any occasion to think of the vast number of uses to which it is put other than for writing or printing upon. Consequently, it may come as a surprise to some of you to learn that the latest statistics put the world's annual consumption at eight million tons, with a normal rate of growth equal 25 per cent in ten years.

India's share of this vast amount is, in comparison with her population, very small. In the United Kingdom, the annual consumption is about one million tons. In India, with seven times the population, it is probably under 40,000 tons. Every

* Paper read at the Indian Industrial Conference, Allahabad, 30th December 1910.

thing, however, points to a rapid growth in the future, the spread of education being of course the governing factor. No truer or more statesmanlike phase was ever uttered than that of Gladstone, "the consumption of paper is the measure of a people's culture," and in the steady growth in numbers of the reading and writing public of India, we can safely foresee a ratio of increase considerably in excess of the normal estimates of the statisticians.

At first glance, it may seem an extraordinary thing that India should be unable to supply even the limited quantity she now uses,—that more than half of it should be imported from Europe. Here we have a country teeming with the raw materials from which paper can be made, and containing also fuel, lime, water and cheap labour—all important factors—requiring only a few chemicals to be imported, and yet the paper mills now at work are not by any means making fortunes and their extension and development has been practically at a standstill for many years. In explaining the causes of such a condition of things, I will divide my remarks into two heads, the first being

*considerations purely Indian* and the second
*considerations purely European.*

Firstly paper must be cheap. Cheapness is the one essential factor to its extensive use, and, I might add, waste. You will realise what this means if you can imagine paper suddenly becoming as costly as the parchment of the middle ages. All waste would at once cease, and we should probably use, for most purposes, ink which would fade out and permit the paper to be used over and over again. Our cheap newspapers would, perforce, go out of existence, and we should never dream of using paper as a wrapper. Considerations like these enable us to understand the very large share that cheapness has in contributing to the total result how a very large proportion of the price of paper—a larger share than in most other manufactures—is represented by the cost of the manufacture. Consequently the raw material must be very inexpensive and to arrive at this necessary cheapness, the paper-maker's raw material market is confined to such materials as are of little or no use for any other purpose whatever. So soon as any materials in

which the paper-maker is interested become of interest to say, the textile manufacturer, the paper-maker's concern with them at once ceases, for the spinner can afford to pay much more for it than he can. Further, and for the same reason, the paper-maker cannot use anything which requires cultivation and has therefore cost something to produce. He is, in fact, in the same position he occupied a hundred years ago when rags and textile wastes were his staple materials. He is a "snapper-up of unconsidered trifles," a user of other peoples' rejections, a gatherer of the waste and,—to other people—the worthless of the fibre world. You will see at once that limitations like these greatly circumscribe the area of his operation. Then, we have to remember that a ton of raw material by no means represents a ton of paper. Taking an all-round average of the class of fibres represented by Bhabar and Munj grasses, it requires about 2½ tons of such to produce a ton of paper. Therefore the cost, *in paper*, for cutting, collection and freight to the mill must be multiplied by 2½. Now India is a country of great distances and long railway hauls, and it will be readily understood that every existing mill has, surrounding it, an economic circle beyond which it does not pay to collect,—from beyond which it ceases to be profitable to pay the costs on raw material when multiplied by 2½. This economic limit has long since been reached by all the existing mills, and no better proof of it can be given than the fact that they actually import wood-pulp from Europe to supplement their local supplies, finding it cheaper to do so than to go further afield to tap the large supplies which undoubtedly exist in many parts of the country.

The mention of wood-pulp brings me to the second division of this part of my subject, viz., *considerations purely European.* These may be summed up in the one word,—wood-pulp. I may explain in passing, that wood-pulp is simply half-made paper—hence technically known as 'half-stuff'—produced from the spruce and fir trees of northern Europe and America. It consists of the nearly pure cellulose or wood fibre, all the waste, amounting to 55 or 60 per cent being eliminated at the wood-pulp factory which is invariably situated as close as possible to the forests from which

it draws its supplies. This division of the paper-maker's labours into pulp-making and paper-making proper, largely explains the low cost of this material, for the paper-maker, instead of paying freight and handling charges on 2½ tons wherewith to produce a ton of paper, can now obtain almost a ton of paper from a ton of pulp.

The extraordinarily rapid growth of the wood-pulp industry is one of the marvels of modern enterprise. Introduced about thirty years ago to supplement the supply of Esparto grass (then the leading staple of English paper-makers) it has gone on growing by leaps and bounds until now 6½ million tons of paper are made from it annually—more than 80 per cent of the whole world's consumption. Its remarkable cheapness gave the greatest stimulus to the newspaper and publishing trades they have ever received. It has made the halfpenny newspaper possible in England and the anna one in India, and has had more to do with checking the development of the Indian paper industry than anything else, for it has introduced into the country a grade of paper exactly suited to its requirements, at a price with which the local mills cannot compete. Thus is accounted for the import into India of European-made paper to an amount of more than half the total consumption.

Its wonderful success, however, threatens to prove its destruction, for the drain on the forests of northern Europe and America, coming on top of the ordinary consumption for building and other purposes, has now nearly reached its limits. Any single one of the great London daily papers, eats its way through the produce of 5,000 acres in a year, and this under climatic and other conditions which do not permit of natural reproduction, except in exceptional circumstances, nor is it conceivably possible to cultivate, at a cost within the limits of the paper-maker, a tree which takes from thirty to fifty years to reach the size required. Whole districts once clothed with virgin forest—nay, whole provinces—have gone galloping down the ever open maw of a hungry press, until now a condition of things has been reached in which the pulp-wood resources of the United States of America are admittedly exhausted and those of Europe considerably curtailed, not only by the recession of the

remaining forest areas into remote and difficult districts, but also by the reduction in the amount of water-power for manufacturing purposes, that being itself one of the results of the forest clearances.

No doubt, in Canada and the remoter regions of northern Europe and Siberia, there are still vast timber areas practically untapped, but the Governments of these countries, warned by what has occurred in the United States, are now fully alive to the dangers of permitting such wholesale clearances and are introducing checks and restrictions, which, in conjunction with the greater distances of these areas from the centres of consumption must have, and already has had a serious effect upon the expansion of the industry. No better proof of this can be had than in the fact that the continuously downward trend of prices of both pulp and paper reached its bottom limit about five years ago, and, while it is probable that for many years to come wood-pulp will hold its place as the leading staple, it is now recognised that it will be unable to overtake the continuous growth of consumption and to provide for this a new source of supply must be found. So strongly has this impressed itself on the circles best fitted to judge that, at the present moment, there is in several parts of the world, an active search being prosecuted both by Government and individuals, for suitable sources of such material. The Director of the Forestry Court of our Exhibition here (Mr. P. H. Clutterbuck) has not been behind hand in contributing his quota to the enquiry, and in the Cellulose Laboratory he has fitted up we hope to take a by-no-means inconsiderable share in this investigation.

We come now to the practical question of upon what lines the extension ofthe Indian paper industry should proceed ? What can be done to render this country not only independent of foreign importations, but to transform it into an exporter ? Let it be said at once that we need not trouble in the least about paper-making—that is, paper-making proper as distinct from pulp-making. The Indian paper trade has shown no want of enterprise in the past and the best proof of that is in the fact that it has now expanded up to the full economic limits of its present raw material supply. Provide new sources of *that* and the paper-maker will do the rest.

In suitable localities erect pulping mills to reduce the local raw material to half stuff, eliminating on the spot the 60 per cent of waste and reducing the freight and handling charges in the proportion of 2½ to 1. Briefly and simply, in *that* lies the future of the Indian paper industry. Nor do we need to confine our energies to what India can use. In the export of pulp to Japan and China there is a market not only already open to us, but which may eventually exceed in volume that required for our own consumption. The import of European pulp into those countries already totals 40,000 tons per annum and is rapidly increasing. This pulp incurs freight charges amounting to from Rs. 35 to Rs. 40 per ton—a very considerable item on a commodity worth Rs. 130 to Rs. 150. From India the freight charges would not exceed Rs. 15 to Rs. 20, so that there is an actual profit visible in freight alone—a bonus in fact—of Rs. 20 per ton.

It is, of course, necessary that a considerable amount of experience and caution be used in the selection of localities for such an industry as I have indicated. Although our Indian forests and waste lands teem with fibrous materials suitable for the manufacture of paper, yet comparatively few of them will make both paper and money. But though the individuals are few, their distribution is of the widest and their aggregate quantity enormous. It is above all things necessary to keep in view the cost of collection and the obtaining of a sufficient quantity within economic range to keep a mill going. This quantity is by no means small. For a grass-pulp mill of, say, 100 tons output per week, 12,500 tons of grass per annum will be required. Still there are many districts where such a quantity, or twice that quantity, would present no difficulty, and in the case of bamboo the supply is literally inexhaustible.

The indigenous materials suitable have by no means yet been fully investigated, but among those known to be satisfactory, I will cite, among annuals, Bhabar or Sabai, and Munj grasses, both of which are largely used by our Indian mills. Among woods, the Himalayan spruce and fir both being, from the paper-making point of view, exactly similar to the woods now being used for the

purpose in Europe and America; and there is of course the already mentioned bamboo, which, I venture to prophesy, will ultimately become the leading staple and hold the position now occupied by wood-pulp. In the districts in which it is most luxuriant cheap water transport can usually be found. It yields a pulp of similar qualities, and by similar chemical treatment, to that now obtained from European spruce. It reproduces itself naturally so that by a judicious system of cutting, a mill placed in a suitable district can depend upon a perpetual supply from the area surrounding it,—a very different state of affairs from those prevailing in the wood-pulp industry, where a mill in a few years cuts out all the timber within economic range and has then either to shut down or remove its plant to a fresh locality.

I have thus briefly, and I hope, plainly, outlined a possibility in Industrial enterprise which even the most seasoned and preternaturally cautious capitalist must admit contains the chief elements of ultimate success. An assured local market, of, say, 25,000 tons per annum, an equally assured export one of 40,000 tons, both of them continually expanding and the latter carrying with it what practically amounts to a bonus of Rs. 20 per ton. A country producing not only the raw material in abundance, but which also provides the important manufacturing factors of fuel, lime and cheap labour, requiring no imports, except a comparatively small amount of chemicals: In these, I venture to say, you have the foundations and essentials of success to a degree paralleled by few, if by any other, industries.

# SCIENTIFIC PAPERS.

## REPORT ON THE RAISING OF FORESTS WITH FIELD CROPS (AGRI-SILVICULTURAL METHOD) IN THE CHIRODI RESERVE, AMRAOTI DIVISION, FROM 1902-03 TO 1909-10.*

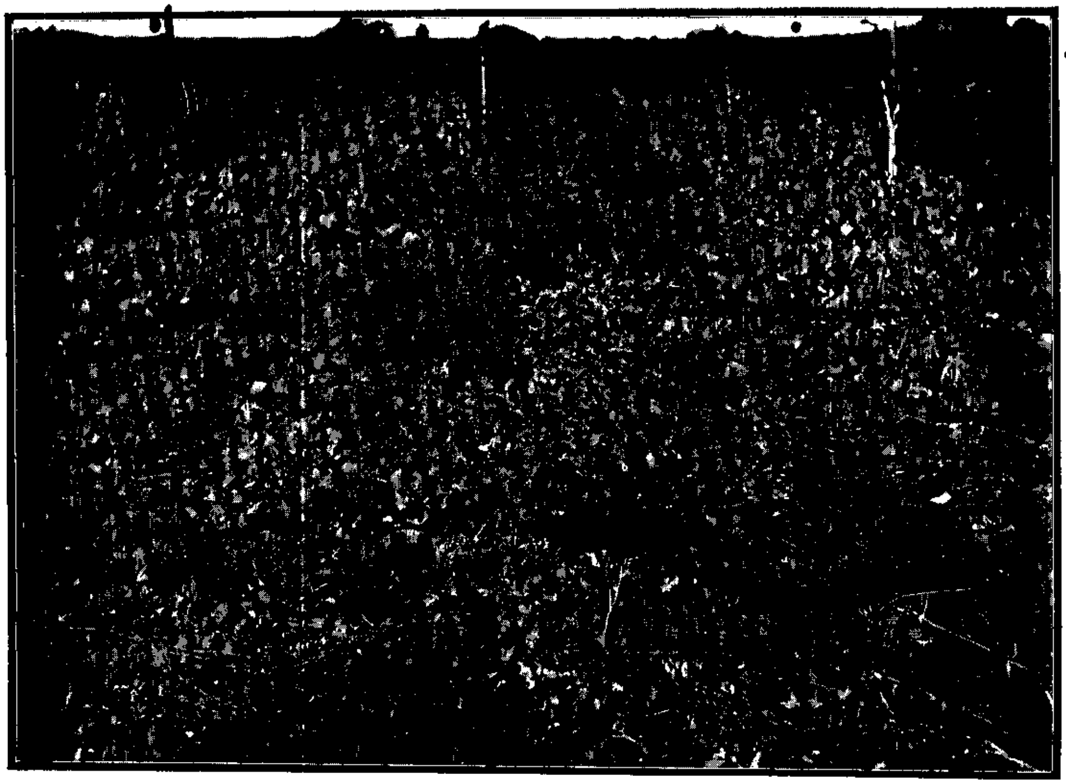
The result of the attempts to restock blank areas in the Chirodi Reserve and other forests in the Amraoti Division are given in para. 75 of Mr. Fernandez' working-plan for the forests of the Amraoti Division.

The methods adopted were the sowing the seeds of forest trees in ploughed lines, prepared patches and broadcast without any previous cultivation of the soil. The species sown were Teak, Bamboo, Babul, Anjan and Tiwas. These operations were a complete failure and the only remaining evidence of them is a few Anjan trees near the Chirodi forest village.

2. The sowing of seeds of miscellaneous forest trees was continued up to the year 1906-07 on land unfit for even temporary cultivation such as steep hillsides and broken land between the foot of these slopes and the land on which agricultural crops could be grown. Shallow trenches were as a rule made by hand along the contours of the steeper slopes and by the plough wherever this instrument could be used, and the seeds of the same species, as were sown with the field crops, were sown in the lines thus prepared. The lines were 6 feet apart on the gentler and 30 feet apart on the steeper slopes.

On 1st June 1902 the area sown up departmentally amounted to 200 acres, 69 acres of which were excluded as a failure during the year; 758 acres were sown up in this way from the 1st June 1902 to the 30th June 1908; of this area 582 acres were sown in the years 1904, 1905 and 1906. In 1902 an area of 76 acres was sown broadcast and the area lightly grazed, but at the end of the

* Appendix I to the Forest Administration Report of the Berar Circle, C. P., for 1909-10.



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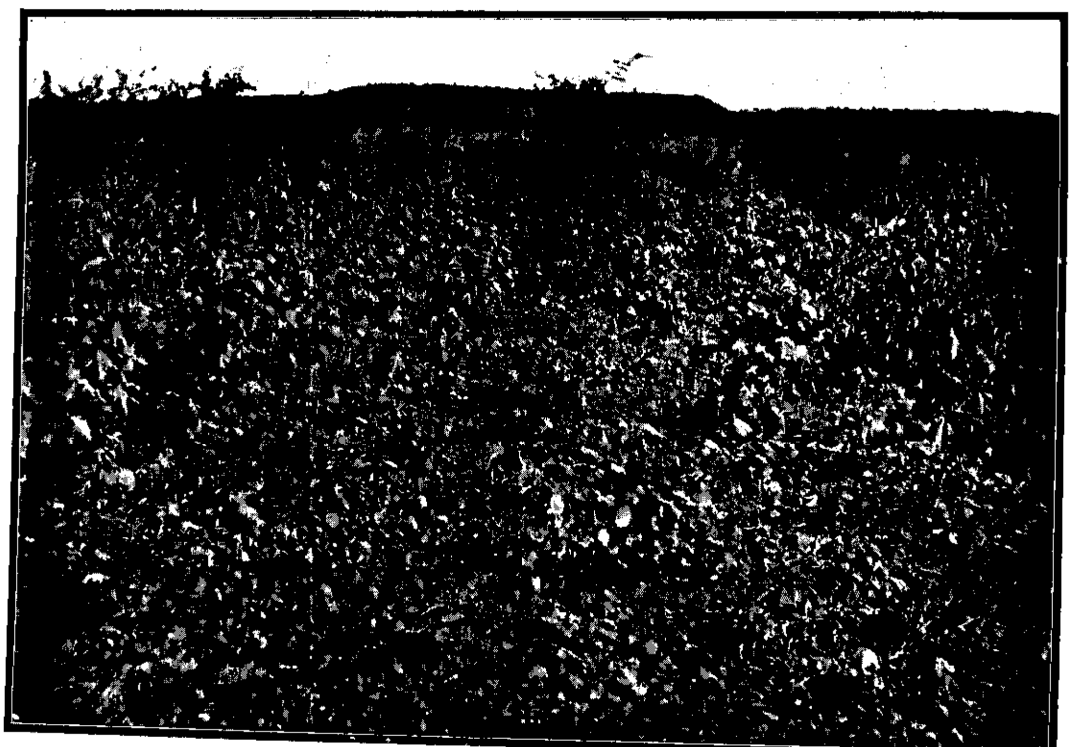


II.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Photos. by C. G. Rogers.

The raising of forests with field crops in Berar.

hot weather hardly a seedling could be seen. The sowings in prepared lines were commenced in the year 1903-04 and the lines appear to have been weeded in the years 1905-06 and 1906-07. Fifty acres on Gol-tekri sown up in 1907 were weeded for three successive years. In the year 1905-06 an area of 163 acres was excluded as a failure and in 1906-07 another 676 acres were excluded for the same reason. The seedlings in the remaining 50 acres, the lines on which have been weeded for three years, were found to be only from 3 to 6 inches high in August 1910, so that this area must be also considered to be a failure. The areas sown up departmentally were inspected last August by the Chief Conservator of Forests and the writer of this report, and very few if any seedlings resulting from the departmental sowings except those already referred on Gol-tekri could be found. The cost of the sowings were :—

| | Rs. |
|---|---|
| (1) Preparation of lines, collection, and sowing of seed. | 1,296 |
| (2) Weeding seedlings ... ... ... | 1,055 |
| Total ... | 2,351 |

or Rs. 3-1-7 per acre.

3. In the years 1900 to 1902 experiments were made on an area of 20 acres in compartment No. 1 of the Warud felling series of the Chirodi Reserve in the sowing of forest seeds with field crops. Three methods appear to have been tried :—

(1) Sowing seeds of forest trees with sesamum in every drill.
(2) Sowing the seeds of forest trees in every fourth drill with sesamum, the intervening three lines being sown with sesamum only.
(3) Sowing forest seeds alone in every fourth drill and sesamum in the three intervening drills.

Seeds of the following species were sown the first year :—

| | |
|---|---|
| Babul ... | ... *Acacia arabica.* |
| Bhosi ... | ... *Bauhinia racemosa.* |
| Ber ... | ... *Zizyphus Jujuba.* |

| | |
|---|---|
| Goti ... | ... *Zizyphus Xylopyra.* |
| Khair ... | ... *Acacia Catechu.* |
| Tiwas ... | ... *Ougeinia dalbergioides.* |
| Tendu ... | ... *Diospyros Melanoxylon.* |

In the second year the area was recultivated and seeds of the same species sown and it was found that the seedlings (chiefly Khair) sown the first year were not killed by the cultivation but threw up strong shoots and were much more vigorous than the one-year-old seedlings resulting from the second year's sowings.

4. In the hot weather of the year 1902 an area of 514 acres appears to have been cut over, divided up into 10 acres plots and given out for three years cultivation on the following conditions:

(1) The cultivator to thoroughly cultivate the land allotted to him and to sow field crops only. The cutting off of all stool shoots thrown up from the stools of the trees felled was allowed.

(2) In the second year every fourth drill was sown with seeds of forest trees, the three intervening ones being sown with field crops. Stool shoots were cut off as in the first year's cultivation.

(3) In the third year the ground was thoroughly cultivated and seeds of forest trees sown at right angles to the lines of the second year's cultivation. After the third year's field crops had been reaped, cultivation ceased, the fields were resumed by the Forest Department, closed to grazing and not weeded. The records which have not been well kept show that 896 acres in coupes I and II of both the Bramhi and Warud felling series were treated in this manner and the land resumed in January 1906 after the crops had been reaped. The field crops sown were *Tur* (Arhar) and cotton.

Six hundred and eight acres in Coupe III of the Bramhi and Warud felling series appear to have been sown with the seeds of forest trees in the year 1905 for the first time and in 1906 for the second time, the lines of the second year's sowings being at right angles to those of the first year. 369 acres

in Coupe No. IV of both Bramhi and Warud felling series was given out for cultivation in 1906.

In addition to the species enumerated in para. 3 seeds of the following species were sown :—

| | | |
|---|---|---|
| Ain | ... | ... *Terminalia tomentosa.* |
| Kahu | ... | ... *Terminalia Arjuna.* |
| Palas | ... | ... *Butea frondosa.* |
| Salai | ... | ... *Boswellia thurifera* |
| Achar | ... | ... *Buchanania latifolia.* |
| Hewar | ... | ... *Acacia leucophlœa.* |
| Nim | ... | ... *Azadirachta indica.* |
| Bharati | ... | ... *Gymnosporia montana.* |

5. In February 1907 I made a careful inspection of the areas sown with forest and field crops and under field crops only. The information given below is extracted from notes made at the time of my inspection.

*Coupes Nos. I and II, Bramhi Felling Series.*

In these coupes the area was cultivated and sown with field crops in 1903 sown for the first time with seeds of forest trees in 1904 (June and July), for the second time in lines at right angles to the sowings of the previous year in 1905 (June and July) and resumed by the Forest Department about January 1906. During the rains of 1906 the area had not been cultivated. Grass and weeds had sprung up during the monsoon which when inspected in February 1907 was from 2 to 4 feet high according to the quality of the soil and the amount of moisture in it. In some places rows of seedlings could be traced in the grass when carefully looked for. They were from 3 to 9 inches high and had very thin stems. These were seedlings resulting from the sowings of 1905 and were therefore 1 year and 8 months old (two full growing seasons). The cross lines of larger seedlings resulting from sowings of 1904, and therefore 2 years and 8 months old (three growing seasons) were seen in a few places in the most favourable localities. They were from 12 to 16 inches high and much thicker than the younger seedlings. Very few if any stool shoots from the crop cut over in

1902 were seen. The three years' destruction of the stool shoots had apparently killed them.

Khair seedlings formed about 80 per cent of the young crop, a fair number of Bhosi and Ber were also found. Practically all the Salai had been rooted out by pigs and Palas destroyed by porcupines. Only a few Babul seedlings were alive, the soil not being suitable for this species.

*Coupe No. III, Bramhi Felling Series.*

This area is still under cultivation. The row of seedlings resulting from the sowings of 1905 (June and July) are traceable in the moister parts of the area. The seed sown in lines at right angles to these in 1906 (June and July) has germinated well and the rows are fairly full of seedlings. Considerable lengths without seedlings occurred. Khair forms about 90 per cent of the young crop. Seed of forest trees was sown in every sixth row, cotton and Tur being sown in the other five. Very few seedlings of the sowings of 1905 have survived the cultivation of the area for the sowing of the third years' field crop. Khair has stood this operation much better than the other species. Very few shoots from the stools of the trees originally standing on the area were seen, and from an examination of areas similarly situated, which have not been cut over, it appears that the growing stock was most incomplete and that there were not many trees to cut over. The lines of forest seedlings sown in a north and south direction are distinctly better than those sown east and west owing probably to being better shaded.

*Coupe No. IV, Bramhi Felling Series.*

This area was given out for cultivation in March 1906 and was under field crops at the time of inspection. Seeds of forest seeds were to be sown for the first time in June and July 1907.

*Coupe No. I, Warud Felling Series.*

This area was cultivated for the same period as the corresponding coupe in the Bramhi felling series. The sowing of forest

seeds have not been nearly so successful and the lines of seed sown in 1906 cannot as a rule be found. Very few two-year-old seedlings and stool shoots were seen.

*Coupe No. II, Warud Felling Series.*

Part of this coupe was sown with forest seeds in the years 1904, 1905 and part in the year 1906. The latter is still under field crops. The sowings of forest seeds in this coupe are not nearly so successful as those in Coupe II of the Bramhi felling series. The 1 year and 8 months old seedlings are only from 3 to 6 inches high. A few 2 years and 8 months old seedlings of Khair were noticed. Very few old stool shoots were seen.

*Coupe No. III, Warud Felling Series.*

This area is still under field crops. Very few 1 year and 8 months old seedlings were seen. The sowings of 1906 were not at all successful. The soil was seen light and sandy and the field crops being extremely poor.

6. Reference to the circle and divisional annual reports for the years 1903-04 to 1909-10 show that in 1905 the monsoon commenced late, the rainfall was short and that the germination of the forest seeds sown was very poor; that the monsoon of 1906 was favourable and the seeds germinated well; that of 1907 was unfavourable while the rains of 1908 and 1909 were good. The rains of 1910 have also been favourable to germination.

7. My inspection of the sowings of forests with field crops showed—

(1) that nothing was gained by sowing forest seeds for two successive years so long as the cultivation of the entire area was permitted as this destroyed nearly all the two-year-old seedlings;

(2) that the seedlings resulting from the three years' cultivation were not strong enough to grow up through the growth of grass and weeds which sprang up as soon as cultivation ceased;

(3) that the cultivation should be allowed for a longer period to prevent the seedlings being suppressed by the growth of weeds and grass which take possession of the area.

8. The cultivators would not cultivate Coupes I and II unless given an entirely fresh lease for three or more years. As weeding the seedlings would be too expensive, I decided to try if light grazing during the rainy season would enable the seedlings to develop and directed that cows at the rate of one animal per acre should be allowed to graze in the areas resumed in January 1906 during the rains of 1907. This has been distinctly successful though in some places the grazing has perhaps been too heavy.

The area was inspected by the Chief Conservator of Forests, Mr. Hart, and myself last August when Coupes I and II of the Bramhi felling series were found to be fairly completely stocked as well as those parts of Coupes I and II of the Warud felling series where the seedlings had germinated fairly well. Khair seedlings form about 90 per cent of the young growing stock.

9. In those portions of Coupes III of each felling series which were still under cultivation and contained a fair number of one-year-old and some two-year seedlings were given out for cultivation for another two years (1907-08) on the following conditions :—

(1) that the rows of one year forest seedlings should be left and field crops raised in the intervening space and that the seedlings of the forest trees should be kept quite free from weed growth ;

(2) that the three leading shoots from old stools should be left ;

(3) that the forest seeds should be sown annually in the blanks in the lines of forest seedlings ;

(4) that the cotton should be sown next to the rows of forest seedlings.

In Coupe IV of each felling series and parts of Coupes I, II and III of both felling series which had not been previously cultivated seeds of forest seedlings were sown in every 6th drill in June and July 1907, the ground between these rows cultivated in

1908 and 1909 and blanks in the lines of forest seedlings sown up each year.

The whole of the cultivated area in Coupes III were resumed in January 1909 and the area opened to light grazing. The result has been distinctly good, the area is much more completely stocked and the seedlings far larger and more vigorous than in Coupes I and II. When inspected with Mr. Hart last August it was found that the seedlings were as a rule higher than the grass, and it was decided that the area should not be opened to even light grazing next year.

10. Six hundred and seventy acres in Coupes V and VI were given out for cultivation in March 1907 and the seeds of forest seeds were sown in Coupes V and VI for the first time in June and July 1908, and blanks resown in 1909 and this year. The results are distinctly good, and in all but the poorest soils the rows of forest seedlings are practically complete, while the oldest seedlings are from 3 to (in the best soils) 6 feet high and will generally be taller than the grass and weeds which will spring up when cultivation ceases. This being the case grazing will only be allowed with the express permission of the divisional officer and then only for a month at a time after the rains have well set in, if it is found that the seedlings are being injured.

Seeds of Anjan *(Hardwickia binata)* and Garari (*Cleistanthus collinus)* have been sown and have grown remarkably well.

In areas where for any reason the growth of the seedlings has been slow (as it always will be on poor dry soil), cultivation will be continued until the seedlings are no longer in danger of suppression by grass and weeds and it is probable that no grazing will be necessary to allow of the seedlings being established. As the area is kept free of weed growth, so long as cultivation is allowed, the extension of the cultivating lease not only ensures the thorough weeding of the seedlings free of cost to Government but the cultivation of the ground for a longer period, which in itself stimulates the growth of the forest seedlings.

11. Owing to the constant change of divisional officers since June 1906 or to the division having been held by an officer in

charge of another division and to the want of interest taken in the work by the range officers the selection of the most suitable species, the proper handling of the seeds, and the study of the treatment necessary to ensure good germination leaves much to be desired and has resulted in Coupes I, II and III of both working circles containing little except Khair, Ber and Ghoti. These mistakes should be avoided in the future.

12. Mr. Bell in his report on the results of the raising of forest with field crops in May 1909 states that 1,349 acres were resumed before that date; 638 acres will be resumed after the crops of 1909 have been reaped, and 656 acres after those of 1910 have been harvested making a total area of 2,643 acres. The cost assuming the cost of the seed sown in June and July 1910 to be Rs. 500, a liberal estimate, and Rs. 1,294 for the reward to be paid on 1,294 acres completely restocked would be Rs. 5,327 or Rs. 2 per acre.

## PHOTOS OF SEEDLINGS OF FOREST TREES RAISED WITH FIELD CROPS.

COTTON AND ARHAR (*Cajanus indicus*) IN THE CHIRODI RESERVE ON THE 9TH OCTOBER 1910.

### PLATE 1, PHOTO NO. I.

COUPE NO. V, BRAMHI FELLING SERIES.

*Field No.* 18.

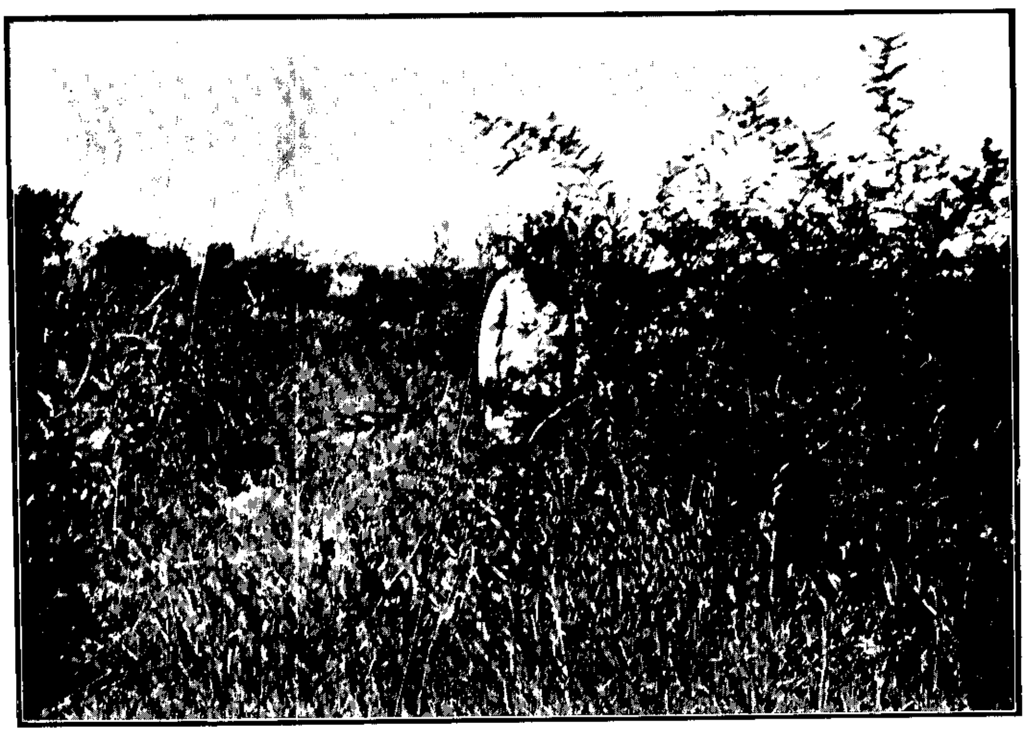
Soil dry and poor, growth bad, field crops stunted. Distance of nearest seedling from camera 11 feet.

Forests seeds sown—June 1908.
June 1909.
June 1910.

Details of seedlings in line commencing with that nearest to the camera :--

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 1. | Bhosi | 4 months | 3 inches. |
| 2. | Khair | do. | |
| 3 | Khan | do. | |

I.



II.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photos. by C. G. Rogers.

The raising of forests with field crops in Berar.

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 4. | Bhosi | 1 year 4 months. | 10 inches. |
| 5. | Bhosi | do. | |
| 6. | Khair | 4 months. | |
| 7. | Khair | do. | |
| 8. | Bhosi | 1 year 4 months. | |

NOTE.—In this light dry soil most of the seedlings die in the hot weather.

Owing to the long break in rains in July most of seedlings resulting from the sowings of June 1910 died.

PLATE 1, PHOTO NO. II.

COUPE NO. V BRAMHI FELLING SERIES.

*Field No. 16.*

Soil good, moisture sufficient, field crop good, cotton, tilli juari.

Distance of nearest seedling from camera 11 feet.

Forest seeds sown—June 1908.
June 1909.
June 1910.

*Details of seedlings in line commencing with that nearest the camera* :—

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 1. | Bhosi | 4 months. | 4 inches. |
| 2. | Khair | 1 year 4 months. | |
| 3. | Khair | do. | 6 inches spreading. |
| 4. | Khair | 4 months. | |
| 5. | Khair | 1 year 4 months. | |
| 6. | Khair | do. | |
| 7. | Anjan | 2 years 4 months. | 18 inches. |

Many Anjan two years and four months old and from 18 inches to 2 feet high in the line beyond the seedlings enumerated.

The subject was selected so as to have youngest seedlings in the foreground of the photo.

PLATE 2, PHOTO NO. I.

COUPE NO. V, BRAMHI FELLING SERIES.

*Field No. 4.*

Soil good, moisture fair, field crops fair, cotton 15 inches high.

Forest seeds sown—June 1908.
June 1909.
June 1910.

Distance of nearest seedling from the camera 11 feet. Details of seedlings in the line commencing with that nearest the camera :—

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 1. | Khair | 1 year 4 months. | 6 inches. |
| 2. | Bhosi | do. | |
| 3. | Khair | 4 months. | |
| 4. | Khair | do. | |
| 5. | Khair | do. | |
| 6. | Khair | do. | |
| 7. | Bhosi | do. | |
| 8. | Khair | do. | |
| 9. | Khair | 2 years 4 months. | 15 inches. |

Many Khair two years and four months old and from 15 inches to 24 inches high in the line beyond the seedlings enumerated. The subject was selected so as to have youngest seedlings in the foreground of the photo.

## PLATE 2, PHOTO NO. II.

### COUPE NO. IV, BRAMHI FELLING SERIES.

*Field No.* 34.

Soil poor, field crops poor, an example of a bad area.

Forest seeds sown—June 1907.
June 1908.
June 1909.
June 1910.

Distance of nearest seedlings from camera 11 feet. Details of seedlings in the line commencing with that nearest to the camera :—

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 1. | Bhosi | 2 years 4 months. | 6 inches. |
| 2. | Khair | 1 year 4 ,, | 6 ,, |
| 3. | Khair | 1 ,, 4 ,, | |
| 4. | Ber | 2 years 4 ,, | 9 ,, |
| 5. | Bhosi | 1 year 4 ,, | |
| 6. | Bhosi | 2 years 4 ,, | |

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 7. | Khair | 4 months. | |
| 8. | Khair | 4 ,, | |
| 9. | Ber | 4 ,, | |
| 10. | Bhosi | 2 years 4 months. | |
| 11. | Khair | 3 ,, 4 ,, | 24 inches. |

Growth of forest seedlings is very stunted and a large proportion of them die in the first hot weather which accounts for the poorness of the results.

There are very few fields as bad as that shown in this photo.

PLATE 3. PHOTO No. I.

COUPE NO. IV, BRAMHI FELLING SERIES.

*Field No. 2.*

Example of an average area where the soil is fairly good and retains sufficiency of moisture.

Field crops, cotton about 18 inches high.

Forest seeds sown—June 1907.
June 1908.
June 1909.
June 1910.

Distance of nearest seedlings from camera 18 feet. Details of seedlings in the line commencing with that nearest the camera :—

| No. | Species. | Age. | Height. |
|---|---|---|---|
| 1. | Hiwar | 3 years 4 months. | 3 feet 6 inches. |
| 2. | Khair | 2 ,, 4 ,, | 2 feet. |
| 3. | Khair | 1 ,, 4 ,, | 1 foot 6 inches. |
| 4. | Babu | 3 ,, 4 ,, | 6 feet. |
| 5. | Khair | 3 ,, 4 ,, | 4 feet. |

This is a good sample of an area where the first year's sowings have been good and most of the seedlings have lived through the first hot weather and is typical of the greater part of the area regenerated by the method of raising forest with field crops where the soil is good enough to produce good field crops for a few years,

PLATE 3, PHOTO No. II.

COUPE NO. III, BRAMHI FELLING SERIES.

*Field No. 7.*

Soil fair, typical of area successfully regenerated of this age.

Forest seeds sown—June 1905.

Do. in line at right angles to those in June 1906.

Do. in same line as in 1906.

Do. in (1) June 1907.
(2) June 1908.

Cultivation ceased in December 1908 with the reaping of the field crops and area resumed by Forest Department. Light grazing at rate of one cow bullock per acre allowed from 1st July to middle of October (Diwali Festival) in 1909 and again this year (1910).

Grass in foreground of photos is 18 inches high. Large Khair nearest to the camera is 19 feet distant and 7 feet high. Seedlings are well above the grass on the area.

C. G. ROGERS,
*Conservator of Forests,*
*Berar Circle, C. P.*

AMRAOTI CAMP:
*9th October* 1910.

## THE EFFICIENCY OF SCIENTIFIC RESEARCH.

(FROM AN ENGINEERING CORRESPONDENT.)

Though we may be more inclined than our predecessors of the mid-Victorian era to look back with sympathy on those who groped for the philosopher's stone or who deluded themselves that an elixir of life was a discoverable actuality, all their labour was inefficient—not only on account of poor equipment, mental and physical, but also by reason of repetitions which must have traversed the same blind alley of futility time and again. For the problems confronting those who conduct research work to-day we are in one sense more efficient by reason of the spread of human knowledge, of organised method, of better instruments, and of the wider interchange of information about accomplished facts. Yet with it all far too great a proportion of the time and money devoted

to modern scientific research is sadly redundant. Every engineer knows of the repeated virtual re-invention of the same device ; but it is doubtful whether there is adequate recognition of the fact that the major portion of unpublished modern investigation and research is a duplication of what has been attempted before. Men are afraid to mark the blind alleys of their searchings with a notice board. They pass on to other paths, and others time and again repeat the same futile cycle. The accruing advantage is small and purely personal. Some small knowledge of at least one thing to be avoided is gained—at least, when men realise why they have failed. To preach new moral duties in a busy age is rather vain, particularly such a moral duty as that of describing a fruitless research and narrating either why success was not attained or why, certain facts being narrated, the anticipated result was not attained for reasons not obvious to the investigator. In regard to the dissemination of information as to fruitless researches there is quite as much inefficiency as there was in the time of the medieval alchemist, and with far less excuse.

Those who undertake research work may be divided into three classes. There are, first, in several countries institutions subsidised by Government or otherwise, such as the National Physical Laboratory. Such an institution can best devote itself to the calibration and certification of standards, and without competing with the independent consultant for commercial routine testing can investigate most points in physics and carry out researches beyond the range of work of those whose daily bread is paid for by the fees obtained from such work. Given efficient administration and zealous work such an institution can in any civilised country make for nothing but good.

Next in importance is the class of research carried out by the experimental departments of large firms. Economically considered the bulk of this is inefficient—not always, because practical results are attained, but to a very great extent when the large amount of duplication is taken into account. In ascertaining the commercial properties, and practical application say of a new material as distinct from the properties of special samples, or

in endeavouring to improve any type of prime mover or new appliance, each firm buys its own experience, and learns for itself the lessons which its rivals have learnt. The interests of shareholders preclude the free exchange of information, and it is only by some arrangement, such as that which in Germany provided the high-speed electric railway experiments by the pooled resources of brains and money of the leading firms, that concerted action is possible. As in this country we lack the genius of co-ordination possessed by Germany it will be a long time before such things are undertaken in Great Britain.

The third class of those who undertake scientific research is seemingly divisible into two sections. The first covers the teaching staff of engineering colleges and technical schools, who are responsible for a large amount of work, both published and unpublished. The advanced students often assist by carrying out a lot of routine work of great educational value to themselves. To a certain extent the colleges in large towns are apt to undertake commercial testing work, such as the tensile tests of iron and steels, for local manufacturers, the fees charged for which go to the college funds. This often interferes with the efficiency of the private laboratory by taking commercial work to which the independent investigator naturally looks for part of his income. The research work carried out by the professors, lecturers, and advanced students of our Universities would be more fruitful if subjects were allocated to various districts, and if the information obtained was freely published.

The second section of the third group is the private investigator. In a country whose characteristic service to science has been pre-eminently individualistic his case demands special consideration. His efficiency is threatened by the competition of State-subsidised research or educational undertakings. He has the greatest incentive to do good work, for his professional repute and his livelihood are dependent upon his success; given equality in mental calibre, he will, because of the great incentive, do work of greater service than the salaried official of the State Apart, however, from this aspect of the case, greater efficiency

might be secured if the private investigator did not, in common with his more comfortably situated brethren, carry out a great deal of repetition work, in duplication of what has been done before or is being done synchronously by others. So far as published researches are concerned, there is no excuse for any investigator who unwittingly reproduces the work of others. Of course, the study of the bibliography of any subject is a long task, and at the end of the study the investigator is equipped to write a monograph setting out the present state of knowledge on the subject, which should save trouble to others. Repetition of delving among published records cannot be regarded as really inefficient, for each man must co-ordinate for himself such knowledge as he has gained. It is wasteful, however, for two competent investigators to work independently on the same subject, if the objects sought for and the methods of investigation are identical. A frank interchange of opinions formed and information gained at intermediate stages would greatly help matters.

It is the problem of the unpublished, because inconclusive, research which is the chief reason for inefficiency. For many years amiable platitudes have been talked about the cosmopolitan nature of science which knows no national borders ; yet our methods have been more narrow than can be described by the word "parochial". By way of remedy, it may be suggested that a committee of a central institution, say the National Physical Laboratory, composed of the heads of its departments and representatives from the leading institutions, should act as a "Research Co-ordination Committee." Any corporate member of the leading engineering and scientific societies who is conducting research work should be invited to keep in touch with the co-ordination committee, who would receive from him reports on his work which otherwise would not be published if inconclusive, and would put him in communication with those working in parallel or identical directions. The Research Co-ordination Committee should also allocate special spheres to the research laboratories of the Universities and technical schools and arrange for the dissemination of information. This need not always imply the multiplication of the

Transactions which crowd an engineer's bookshelf. The loan of type-written copies of the manuscripts in question would meet the need in many cases. By such a committee, no man would be defrauded of any prestige due to his ability and originality. He would indeed receive credit for work done which ordinarily would not be published. Finally, repetition and redundancy would be diminished, and a means afforded for increasing our national efficiency through the reduction of futile effort. Commercially, we safeguard our carrying trade by the publication of charts and the buoying of shoals and rocks. It is about time that we considered applying common sense to the co-ordination of scientific research.

Quite apart, however, from the need for co-ordination, thought should be given to the position of the independent investigator. This is not the occasion to allude to the brilliant services done to scientific progress by the individual; but the continued value of such service cannot be an enduring national asset if the competition of the various laboratories, national and collegiate (which, thanks to endowment and subsidy, have no capital charges to meet, and could continue to do valuable work if they left commercial work alone), is to drive the independent consultant to seek other means of livelihood.

# ORIGINAL ARTICLES.

## ON THE SELECTION OF A REPRESENTATIVE RADIUS.

An article by 'Op under the above title appears in the August number of the *Indian Forester*. In this article the author states that "the object in view is to select a radius which shall throughout its length show a series of annual rings truly representative of the various stages of its life." He goes on to say that there are two opinions on the choice of this radius: the first that the radius should bear a constant proportion to the size of the tree for all trees, and the second that each tree should be considered separately and the observer should choose that radius which appears to him to be most representative. 'Op prefers the former method and I

should like here to put forward a few points in favour of considering each tree on its own merits. Before going any further let me attempt a clearer definition of a representative radius. A representative radius is one on which the thickness of each ring bears the same ratio to the radius as the average thickness of that ring bears to the average radius. By the average radius I mean, the average of innumerable radii drawn from the pith to equidistant points on the circumference of the stump. It is equal to the radius of a circle equal in area to the section on the stump. It is the true arithmetical mean radius whether the stump is circular or ellipse.

If the representative radius could be obtained by any rule there would be very little difficulty in calculating the rate of growth. Teak, however, has a very irregular growth as a general rule. The stumps show that growth has been rapid first on one side and then on another. Buttresses form, in consequence of rapid local growth at one or two points which afterwards show retarded growth while buttresses are forming elsewhere. These and other factors tend to produce uneven growth, and I am prepared to state that I do not believe it possible, on most stumps, to find any one single radius along which the growth has been representative of the growth of the tree. Much less therefore would it be possible to get a representative reading on a radius fixed by rule. Why should the reading along any mean radius (arithmetic, geometric, or harmonic) be any more likely to give a representative reading than any other radius? A representative radius may just as well be the longest or the shortest radius and indeed I believe is far more likely to be so, as on these two radii there is some likelihood of each ring attaining its broadest or its narrowest limit and therefore bearing the same ratio to the radius as the average thickness of the ring bears to the average radius. On the mean radius, on the other hand, some of the rings would be broader and some narrower than their average thickness, and these radii would for that reason very seldom give a representative reading.

Let us get to the root of the matter. What would be the most accurate way possible of finding the true rate of growth on

the stump? The average thickness of each ring would have to be measured by taking the mean of measurements taken at a large number of equidistant points all round the ring. The average increase in radius during any period of life could be accurately measured in the same way. Thus if periods of 10 years were taken and the average increase in radius put on during each period accurately determined as above we should get the rate of growth very approximately, and the greater the number of measurements of the radial increase in each period that were taken the more accurate would be our results. The above method would be impracticable but indicates a very accurate method. We can approximate to this by taking as many measurements as is reasonably possible and this is what I would propose. Three, four or more radii should be selected and along these radii the radial increase of each period of 10, 20, or 30 years should be measured. This differs somewhat from the usual method and indeed from the method I have used myself. Usually the radius is divided proportionately to the girth classes and the number of rings falling in each girth class is noted and shows the number of years spent in that girth class. This gives rise to an error, as some of the rings that are included in one girth class might have been produced either before or after the tree reached the limits of that girth class, unless of course the radius was representative, which is improbable. If the girth at different ages is measured on all the stumps examined, it is very easy by means of a curve or calculations to tell the age at any fixed girth and the number of years spent in each age class.

These several radii along which readings are to be made must be selected by the observer as those most representative. Then of course in comes the little matter of personal equation, about which 'Op makes such a fuss. What is this personal equation after all? I do not think that different observer's ideas of a representative radius differ much. I have tried to define my idea of it above and it seems all right to me, but if 'Op and others think differently the matter is certainly a little difficult. There remains the individual judgment, but there is very little room for this

provided a certain amount of common sense is used. As a representative radii is usually impossible we must try and get as near to it as we can. The counting along many radii will be found to be impossible for various reasons, while common sense will tell us to avoid others, and the consequence is that the number of directions in which radii can be taken will be limited, and if several radii are taken there will not be very much play for the individual judgment.

As to how many radii should be selected, that is a matter of the time at the disposal of the observer. On working-plans when time is precious and a large number of stumps have to be counted, I have considered it sufficient to count along three radii as a general rule, and have further always tried to count one radius respectively greater than, about equal to, and less than the average radius. For more leisurely work, I would recommend the examination of five or six radii if available.

The method outlined above may be somewhat more laborious than the method of a mean radius, but will, I think, give far more accurate and satisfactory results.

Another matter to which I should like to draw attention is mentioned in the last sentence in 'Op's article which I will quote. " Measurements on marked trees in the forest, so far as these have gone, seem not to substantiate working-plan estimates of growth but rather tend to show that the latter are generally too sanguine." Might not this be due to our method of arriving at the breast girth of the tree, the stump of which is being examined? This is usually done, I believe, either by taking the mean of the greatest and least diameters on the stump or by measuring the circumference of the stump with a tape. Bark allowance is usually added to this. The height of the stump rarely exceeds 2 feet and is usually lower, while breast height is considered as 4½ feet. The taper between the height of stump and breast height is often considerable, and if we apply the rate of growth at stump as compared with the girth of the stump to trees which are measured at breast height, we are laying ourselves open to an error, the result of which would be to give a faster rate of growth than is actually the case.

RADIUS.

## FORESTS IN THE FEDERATED MALAY STATES.

In the September number of the *Indian Forester* appears an article by Mr. C. G. Young, a junior member of the Federated Malay States' forest service, entitled the "F. M. S. Forests." The article does not apparently attempt to describe the forests, but is a rather disjointed and inaccurate account of methods of working and of the forest regulations and rates of royalty, etc.

Some of the statements made, appear to me to be so inaccurate and misleading, that I venture to send this correction which, in the interests of the Federated Malay States, I hope you will find space for.

At the commencement, in describing the country, it would be well to mention that open work tin mines occupy a considerable space in the plains and valleys. The view from a hill near Kuala Lumpur, the capital of the Federation, will show miles of country devastated by tin workings, innumerable water-holes and mounds of subsoil, and often deserted workings covered with "lalang grass."

For miles around such workings the forests have been practically devastated.

However, the total area of alienated land for mining and agriculture at the close of 1909 was only 1,378,794 acres about 8 per cent of the whole area of the Federated Malay States. The first serious error, however, is contained in the statement that "metalled roads are scarce."

There are in the Federated Malay States 1,875 miles of splendid metalled roads, the area of the Federated Malay States being 27,300 square miles, much of it composed of a high mountain range, more or less inaccessible.

The plains and foothills are intersected with roads and nearly all reserves can be approached by them. Government is now supplying many of its officers with motor cars. Under *State Land*, Mr. Young says, in talking of licenses, that "each man can cut what he likes." This is a somewhat surprising statement from an officer who has passed the Rangers' examination in the local forest law, and is quite incorrect, as in the license must be

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by B. H. F. Barnard.

The Forests of the Federated Malay States.

Gutta Percha trees (Palaquium oblongifolium) freed by girdling of inferior species.

entered the kind and quantity of the forest produce to be cut and removed.

The reference to the share of opium duty formerly credited to the department in exchange for free firewood was about one-thirtieth, not one-fourth.

The acreage of improvement fellings done in the reserves mentioned in 1909 was 424 and 500 acres respectively, in one reserve in Perak 1,098 acres, not as is stated about 100 acres annually.

As regards the Pondok Tanjong Government rubber plantation about 250 acres in area, it produces at present 5,000lbs. per mensem, and the average monthly yield for this year to date is about 4,000lbs., the cost, I am afraid, is considerably more than 1*s.* It is more like 1*s.* 3*d.*

As regards the stricture on the Malay labour, *i.e.*, labour for silvicultural operations, it is true that the Malay is inclined to be lazy; but, as a rule, he is intelligent, and in Pahang quite an unusual degree of intelligence has been displayed by Malays in executing improvement fellings. He is expensive, but when supervised and encouraged, does excellent work.

As regards labour on timber extraction, that is done almost entirely by Chinese, but the Malays do a great deal of the collection of minor produce, such as canes, damars, wild rubber, etc. The average cost of up-keep of reserve boundaries in 1909 was $7 per mile and in Perak as little as $3 in many cases.

In time as the cut lines become used as paths, the rate should fall to an average of $3 or even less.

I must conclude by saying that the figures for yield of the two species of trees mentioned at the foot of the article are quite unreliable and far below the average.

A good Chengai tree *(Balanocarpus maximus)* will yield 200 sleepers or more, which for the gauge used here means about 435 cubic feet.

The trees cited were overmature and unsound, the exploitable size for Chengai being about 8 to 9 feet and for Merbau, 6 to 8 feet, whereas the average girths taken for calculation in this case are 11′ 9″ and 13′ 1″.

The Chengai tree has no sapwood, sound trees of 8 feet and 9 feet girth are common with a clear bole for 60 to 80 feet without a branch.

Plate 4 shows a gutta-percha forest in which trees of other species have been felled or ringed to give light and air to this important tree. It will be seen that the result is an almost pure gutta-percha forest.

KUALA LUMPUR:
11*th October* 1910.

A. M. BURN MURDOCH,
*Conservator of Forests, F. M. S. & S. S.*

# WOOD-PULP TESTING AT THE FORESTRY COURT CELLULOSE LABORATORY, U. P. EXHIBITION.

BY W. RAITT.

The chief purpose of the work now being carried on in this laboratory is to discover whether any of the woods produced in the forests of the United Provinces, which have little or no value as timber, can be given a paper-making value. Those of them which can satisfy the test will thereby acquire an interest they do not now possess and an additional claim to conservation and protection, and, at the same time, their inclusion in the world's reserves of paper-making material will make a considerable contribution to the solution of what is becoming a serious problem owing to the rapid diminution and possible exhaustion of the pulp-wood resources of northern Europe and America.

The hill forests of spruce and fir present no serious difficulty. It is known that they will yield pulp of as good a quality as their congeners of northern latitudes, although there are several points yet to be settled respecting the cost at which they will do it; but the low country forests introduce factors that are new to pulp-makers, such as the fact that they are usually mixed forests, no one species predominating, and also, the effects on the fibrous tissue of tropical conditions of growth under extremes of climate in the direction of moisture and drought rather than of heat and cold, as is the case in Northern Europe and America.

The former (mixed forests) resolves itself into the problem of a selection of species suitable for treatment by the *same process.* One species may not, in a given district, supply a sufficient quantity to keep a mill going, but several may, and if they differ slightly in the *degree*—as apart from the *system*—of treatment required, it would be quite possible for the mill to work for a week or month on one and then change on to another, provided they are all amenable to the system of treatment for which the mill has been designed. It is therefore necessary to test the woods for their suitability for reduction by the soda, sulphate and sulphite methods and to make selections accordingly, and the aggregate yearly quantity available of each selection is the main factor in the fixing of suitable manufacturing localities.

The conditions of growth have not, so far, shown any appreciable effect upon the cellulose itself in its percentage amount or in the character of the individual fibres; but several species show the effects of infiltration of curious compounds which, in combination with soda, produce strong colourations upon the pulp ranging from dull clay yellow to deep chocolate brown and they are most marked in species like *Salix tetrasperma* growing in low-lying damp situations. All are insoluble in cold water: most of them are soluble in hot water and can therefore be dealt with: a few are insoluble and unbleachable by any practicable method of treatment governed by the soda method. They may prove tractable under acid treatment. A complete scheme of examination of each species covers the following ground :—

(1) Complete analysis of the sample, with observations of the extent to which hydrolysis of the cellulose occurs.
(2) A preliminary digestion with a standard percentage of soda to obtain indications as to which method of reduction is most suitable.
(3) Repeated digestions by the method thus indicated to arrive at the minimum quantity of chemicals required
(4) Test of the percentage of recovery of chemicals possible.
(5) Bleaching test.

(6) Determination of the pulp yield both in the bleached and unbleached condition, calculated on the air-dry weight of the raw material and on the bulk, *i.e.*, per cubic metre or cord of stacked logs.

(7) Microscopic examination of the dimensions and character of the ultimate fibres.

With some forty species to investigate, it has not been possible as yet to put the above scheme in operation in its entirety, nor is it at the present stage necessary. Obviously, not all will prove suitable, and efforts are at present being directed to weeding out the unsuitables so as to permit of more concentrated attention to those giving promise of usefulness. They are, therefore, being put through a modification of the full treatment intended to bring out the leading points of yield and probable cost of treatment, and to obtain indications of the treatment most suitable in each case. Those which fail to reach a certain standard are rejected, while those which survive are considered to have earned further consideration by proving themselves to be payable pulp-yielders.

They are, therefore, first subjected to a rapid analysis for cellulose only. If this reveals a total cellulose percentage of not less than 45, they are passed for further treatment. By any system of reduction the loss of fibre by hydrolysis and oxidation is considerable and varies from 5 to 10 per cent. with acid treatment to from to 8 to 15 per cent. by alkaline. A sample showing 45 per cent. by analysis might therefore yield only 30 to 35 per cent. in practice, which is getting dangerously near the non-payable line. Besides this, a low cellulose contents means a high percentage of incrusting matter, and it is the latter which governs the cost of chemical treatment. (It will be understood that these remarks apply to woods only. For grasses somewhat different standards would be adopted.) The sample is then submitted to the preliminary digestion test with soda (sodium hydrate) referred to in (2) above, at a standard density equal to 20 per cent. on the air-dry weight of the sample. If under this treatment a yield of not less than 40 per cent. of unbleached pulp is obtained, the species is classed as a payable pulp-yielder and reserved for full investigation.

The soda method is preferred for this test: firstly, because it lends itself best to rapid laboratory work; and, secondly, because it is the best "cover" test of the three available. It either reveals itself as the best for the sample under treatment, or, by observation of the behaviour of the material under it, indications are obtained as to which of the other two would be preferable. As it is the severest test of the three, we know further, that if good results have been obtained by it, then still better ones—certainly in yield and probably in cost—will be obtained by the other method which it selectively indicates.

Among those tested up to date, the following have come up to the standard fixed on under this test of a 40 per cent. yield of bleachable pulp with a soda consumption of not more than 20 per cent. They are arranged in classes according to quality:—

| | | |
|---|---|---|
| I.—Picea Morinda | ... ... | Long fibred strong pulps of good colour and excellent quality. |
| Abies Pindrow | ... ... | |
| Pinus longifolia | ... ... | |
| Do. excelsa | ... ... | |
| II.—Bombax malabaricum | ... | Fibres not so strong as the above, but good useful pulps. |
| Populus ciliata | ... ... | |
| Trewia nudiflora | ... ... | |
| Sterculia villosa | ... ... | |
| Ficus bengalensis | ... ... | |
| Salix tetrasperma | ... ... | |
| III.—Grewia tiliafolia | ... ... | Short, weak fibres of easy bleaching quality. Suitable for mixture with stronger pulps. |
| Do. oppositifolia... | ... | |
| Do. Hainesiana | ... | |
| Kydia calycina | ... ... | |

Among those rejected so far, are *Odina Wodier*, *Anogeissus latifolia*, *Terminalia belerica*, *Holoptelia integrifolia*, *Mallotus philippinensis*, *Morus alba* and *indica*.

The rough general rule that suitability for pulping is in inverse proportion to density holds good with all the species tested. Up

to 35 lbs. per cubic foot of dry wood reduction is easy; from 35 to 40 it increases in difficulty, beyond 40 impossible within economic limits, except in rare instances. Of course, any wood will yield pulp if no limit is placed on cost, but there is nothing to be gained in wasting time and effort on economically impossible propositions.

A feature of our apparatus which deserves mention is the higher pressures to which we can work than has hitherto been the rule in laboratory practice. Our digesters have been constructed to work up to 175 lbs. per square inch. As pressures of 140 to 170 lbs. are now not unusual in mill practice the older type of experimental digester working to 80 or 100 lbs. fails to give an accurate reflex of what occurs in large scale practice. The available field of experiment is thus considerably enlarged, for many woods which fail at 100 lbs. prove quite useful at higher pressures. ur standard of a minimum yield of 40 per cent. with a maximum soda consumption of 20 per cent. is admittedly a high one, but it is less high with a pressure limit of 175 lbs. than it would be at 100.

We hope on another occasion, after our weeding out process is complete and the selected species have been submitted to full examination, to return to the subject armed with more detailed information than is available at the present stage.

## FOREST RAILWAYS FOR THE EXTRACTION OF TIMBER IN BURMA.

### DOUBLE RAIL AND MONORAIL.*

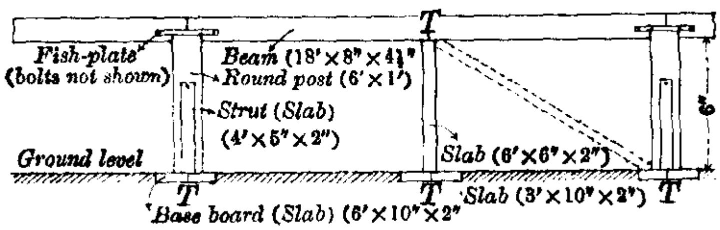
The accompanying descriptive notes are based on Messrs. Macgregor and Co.'s 2-feet gauge railway in Toungoo and Pyinmana and on Messrs. The B. B. T. Corporation's Monorail in Pyinmana. The latter is the first of its kind in the East.

The subject is of more than local interest. The old order of things is changing. Although nearly all the hauling of teak logs

* The author has sent us 19 photographs to illustrate these notes, but we regret that we are unable to publish any of these at present.—HON. ED.

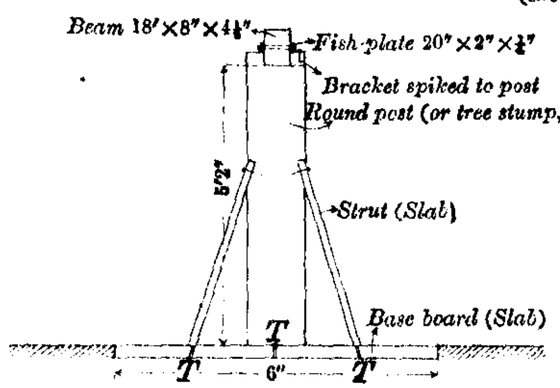
# THE SHREWSBURY MONORAIL

*Longitudinal view of track without iron rail (Scale $\frac{1}{80}$)*

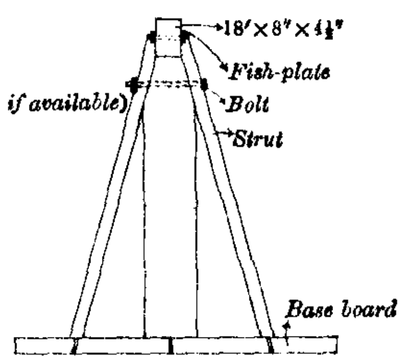



*(The dimensions of slabs indicate minima; extra thickness is immaterial.)*
*T, T = Tongues; all 2'*

*End view of track (Scale $\frac{1}{15}$)*




*End view of track (Scale $\frac{1}{15}$)*
*(showing another method of fixing side struts.)*



to floating streams is still done by elephant throughout the province, firms are beginning to realise that rough unmetalled cartroads are not everywhere the cheapest form of track and that elephants are not everywhere the cheapest form of "prime mover." The prices of elephants have been steadily rising for many years past. Moreover their liability to disease is a constant source of anxiety. Under their leases firms have to be given a very free hand in the arrangement of their operations. They cannot be tied down to work any particular locality in any particular year. Latitude must be given. If a serious outbreak of anthrax occurs in a forest, elephants are at once moved elsewhere, and the infected area is left alone for two or more seasons. During the year just closed 40 casualties occurred amongst the 265 elephants employed by the three large firms at work in Pyinmana. What the annual death roll is in the whole province I cannot say, but it is probably considerable.

The figures given at the end of this paper show that a light railway can be run with profit for teak for such a short length as 6 miles. By so much the more would it pay for a longer lead. It may therefore well be asked whether the field is not a still wider one and whether there is any opening for the use of railways for species other than teak.

The past decade has seen a very remarkable development in the timber trade. Not so very long ago teak was the only species worth bothering about. In earlier working-plans other species were hardly mentioned at all.

Expansion of the provincial railways is responsible for a good deal of the increased demand. Every mile of new line means 2,000 sleepers for construction. Taking the life of a sleeper at 10 years, every mile of existing line means 200 sleepers a year for maintenance. A few years ago a trial was made with Jarrah from Australia. The experiment is not likely to be repeated. It is fairly certain therefore that the Burma railways will be glad to take all the locally grown sleepers they can get for many years to come. Pyingado has already an established reputation and other species such as Ingyin, Thitya and Tauk-kyan have considerable

chance of finding extensive use in the near future. The trade simply wants encouragement to establish itself. One point more—there is every likelihood of a big market for Pyingado outside Burma. The development of export will simply depend on whether the Burma railways are always to be given a preferential claim on the most accessible forests and whether they will always be able to appreciably reduce export by high rates. At present the rates for the carriage by rail of sleepers not purchased by the Company are higher than for other sizes.

Pyinmana is perhaps *the* division in Burma in which the urgent need for the laying down of light railways into the forests has already made itself felt for species other than teak. Six years ago development of the trade in Pyingado sleepers was seriously taken in hand and the outturn is now about a lakh of sleepers a year.

The Burma Railway Company would gladly take four times this amount if the forests could easily supply them, but it has proved to be an absolute impossibility to turn out more than is done. Carting is the difficulty and imposes a very effective check on expansion. When one sees the mountains of paddy that accumulate in station yards all down the line in the cold weather, it ceases to be a matter for surprise that cartmen very much make their own terms. The supply is quite inadequate, and the first effect of any attempt to bring in more sleepers by road would be a general raising of rates, without a corresponding increase in outturn.

Sleeper work in Pyinmana is regulated by a 25-year scheme which includes only those forests that are within 25 miles of the railway. The coupes are estimated to yield a lakh of sleepers annually. The Pyingado bearing areas outside the present scheme are twice as large as those inside it. The whole division could, I believe, easily supply four lakhs a year.

It is very likely that the Railway Company will themselves soon run a branch line to tap the forests outside the sanctioned scheme in the south-western part of the division. This will mean another lakh of sleepers a year

A private firm is already negotiating for a long lease of forests in the extreme south of the division. Their idea is to run a light line of their own into the forests and to turn out a lakh of sleepers annually.

4. Further, let me refer to another point of the compass, north-west of Pyinmana and 16 miles from it is the village of Mingon. It represents the farthest limit in that direction of the present Pyingado scheme. North and west of Mingon and within 15 miles of it, enumerations show that when the working-plans were made some years ago there stood Pyingado trees over 7 feet girth representing 20 lakhs of sleepers. The trees are still there and are likely to remain so—and rot—under present conditions.

From Mingon to Pyinmana a cart-road is now under construction. A light 2-feet gauge railway could easily be laid alongside it at very little cost for earthwork. Would it pay to build such a line 16 miles long and to maintain it till the rails rust to pieces for a lakh of sleepers a year, to say nothing of the paddy and other traffic that it could attract? The answer seems clear. It is not however a simple question of the relative cheapness of railing *versus* carting. I started by stating that the sleepers will not be sawn at all if carts are all that are to be depended upon to get them to the market.

If prospects are good for one species, how much better for a conbination of several! The biggest item in the initial cost of a railway being the rails themselves, anything tending to increase the outturn per square mile of forests is so much to the good. In future leases preference should be given to the firm that is prepared to work other timbers besides teak, and other sleepers besides Pyingado.

In this connection also it is to be remembered that a high girth limit tends to diffusion of working. Lowering of the limit for Pyingado from 8 feet to 7 feet might in many places mean all the difference between a poor speculation in railways and a splendid investment.

Pyinmana is indeed an example of a division in which the possibilities in light forest railways would be hard to beat. The

possibilities seem so large in fact that their very magnitude make one fight shy of attempting to tackle them departmentally. The field seems distinctly large enough to attract private enterprise.

MESSRS. MACGREGOR'S 2-FEET GAUGE RAILWAY.

Double Rail.

Messrs. Macgregor and Co. hold a long lease for the extraction of teak from the Toungoo Division. One of the forests—the Saing-Yane Reserve—contains some of the finest timber in the province. This is probably due to the fact that a good deal of dragging over difficult country is necessary in order to put logs into a good floating stream. The drag is anything from 5 to 10 miles and the last 5 miles is all along one route. The country being hilly and the timber being exceptionally heavy, Messrs. Macgregor decided about three years ago to try the experiment of doing the hauling by rail instead of by elephants. A start was made with three miles of track; subsequent additions bring the present total up to six miles. The rolling stock consists of 11 pairs of bogie trucks and a locomotive.

Description of the track.

The line consists of 18lb. rails spiked down to sleepers of $3' \times 4\frac{1}{2}'' \times 4''$ (about) laid some 2 feet apart. About 25 tons of sawn timber are required per mile for the sleepers. The whole affair looks absurdly small beside a metre gauge line. Nevertheless it is quite strong and durable enough for the work it has to do.

The line does not run straight down a level valley. It crosses several streams and low hills, giving the track very much a switch-back appearance. Messrs. Macgregor have spent as little as possible on cuttings and embankments. Gradients are anything up to 1 in 40.

At the time of my visit to the line in March last, the engine was temporarily laid up with internal troubles, and the hauling of the trucks was being done by coolies. My day's experiences were as follows:—

Early in the morning I rode to the upper terminus at Minye and found about 40 coolies busy loading the logs on to the trucks. By 9-30 the day's consignment of seven logs was ready, and they

started off one by one at short intervals, each in charge of two men. On the down grades considerable speed was attained, and this was quite sufficient to carry the logs over most of the rises. It was only where a steep climb and a sharp curve came together that the coolies had to get off and push. Small logs also ran more easily than heavy ones. Where the two men in charge found themselves unable to move ahead, they waited for the next log. Four men could manage the most difficult places and the biggest logs. By noon all the seven logs had arrived at the lower terminus, Sabein. The coolies then joined forces and tipped them off the trucks. This took about an hour. They then trollied themselves on the empty trucks back to their camp, about half way up the line. I was told that, with the engine, two trips a day could be done, total 22 logs hauled a distance of 6 miles.

The attached letter and statements, kindly supplied to me by Messrs. Macgregor, give details of the expenditure on, and of the work done by, the line up to date. The results are highly satisfactory, and speak well for the chances of success of similar undertakings elsewhere.

THE SHREWSBURY SELF-BALANCING MONORAIL SYSTEM.

Prior to the advent of the Brennan gyroscopic car, monorail carriages were all top heavy concerns. In the Caillett system arrangements for balancing the cars have to be made. This is either done by tying each car to the animal dragging it, or by the use of the Ewing patent balance wheel, which runs on the ground to one side of the rail. It is hard to imagine that there is any great advantage over the ordinary double rail track in this lop-sided arrangement. The monorail system described below is totally different. The general idea is to raise the rail above the ground and to support the load to be carried on either side and well below the level of the rail. The cars are therefore distinctly *self-balancing*, and the retention of the essentially monorail character of the track gives full play to the advantage this method has over the double rail, namely, that it has considerably less friction to overcome.

Before describing the system in detail it will be as well to mention that it is still in the experimental stage. The prospects

of success are however so good that the system deserves to be widely known. It is particularly well adapted for use in forest where plenty of timber is generally available close at hand for construction and repairs.

The idea of transporting logs by means of a self-balancing car running on a single elevated rail occurred to Mr. Shrewsbury some years ago when working for Messrs. The Bombay Burma Trading Corporation in Siam. A rough track built out in the jungles with any materials that were to hand proved so satisfactory that Mr. Shrewsbury went home, worked out details and patented his invention. A model of the monorail and car was a feature of the Machinery Exhibition held at Olympia in 1907. The patent is in the car and not in the track. The latter anyone is at liberty to put up.

Before deciding whether to purchase the patent rights from Mr. Shrewsbury, the Corporation asked for a trial and agreed to find the funds for the experiment. The Byingye forest in the Pyinmana Division was chosen as a good locality in which to test the capabilities of the monorail. The results obtained are very instructive and tend to show that this method of transport does answer expectations from an engineering point of view. The idea is admitted to be good, and it only remains now to work out the practical details of the best form of track and car. Unfortunately the Corporation is content to let the matter rest here, and is not prepared to go any further with the trials. When Byingye was first chosen it was estimated that there would be enough timber in it to make it worth while to set up some six miles of track. Later estimates make this doubtful and so the whole of the projected line is not to be built, and the experiment has been abandoned. Mr. Shrewsbury is therefore now free to offer his invention to the public, although it is doubtful if he will be able to give it all the publicity it deserves without assistance.

The cars.

The idea of the car which carries the load is very much that of the banghy. The car is carried on a pair of wheels about 12 feet apart (or two pairs if bogies are used). The framework to which they are

attached has arms projecting on either side from which the load is suspended, half on one side and half on the other. Any kind of platform can be used. Sleepers can be carried as easily as logs. By converting the platforms into boxes, the cars would be suitable for the carriage of small stuff such as paddy.

With logs, exact equally in weight cannot be obtained, and so in practice, in order to balance the car, there is a screw arrangement for adjusting the distance of the load from the centre line. With small stuff such as firewood, sleepers or paddy this is not necessary, as the load can be built up equally on both sides without any trouble.

It is noteworthy that the centre of mass of the loaded car is from 3 to 4 feet below the top of the rail. Equilibrium is therefore quite stable. It is impossible for a car to turn turtle, and smooth running is simply a matter of the quality of the workmanship put into the track itself.

The track.

Mr. Shrewsbury's original idea was to let the wheels run on a wooden rail. The wheels had a broad tread of about 4 inches and were without flanges. They were kept on the track by small side rollers with vertical axes. Considerable play was left between these rollers and the rail as there was no need for them to grip it tightly.

Engineers at home persuaded Mr. Shrewsbury to introduce a metal rail and to use flanged wheels instead of the side rollers The Byingye track and cars are of this description. The results are not satisfactory. It is true that the design of the cars is somewhat simplified, but on the other hand the extra expense is considerable. The price of the iron rail itself is a very big item, *more than half as much, in fact, as the cost of erection of the whole of the wood track.* Moreover it is very probable that the wood rail would give excellent results by itself. This is much more likely to be the case in Burma than in England. Hard and durable timbers are dear in Europe, soft woods are cheap. In Burma it is just the reverse.

Circumstances may arise in any particular case making it advisable to go in for an iron rail, but this is not likely to be true

for the majority of the localities in which the monorail stands any chance of success for some years to come in Burma. It is simply a matter of expense.

One of the chief reasons for the abandonment of the Byingye experiment was that a lot of money was thrown away at the start in the use of *inferior* timber. As the track was only wanted for a couple of seasons, it was thought that any jungle woods would be good enough. Over three miles of track thus built more or less fell to pieces after white-ants had been at work on it for less than a year. A fresh start was made and a quarter of a mile was rebuilt with good timbers. Results were very satisfactory, but a lot of valuable time had been lost as well as money spent and so the Corporation, as already stated, decided not to proceed further with the experiment.

The accompanying diagrams (Plate 5) give a good idea of the general arrangement of the track, and show details of the timbers and joints. The dimensions of the timbers naturally depend on the size of the load and on the qualities of the timbers used. For a live load of 6 tons and species such as Pyingado, Thitya or Ingyin longitudinal beams 10″ × 6″ in section should be sufficient and for loads up to 4 tons 8″ × 4½″ should be ample. The length should be 18 feet as this is the commonest size in the market and is also a multiple of the metre gauge sleeper length (6′ × 8″ × 4½″). The beams have butt ends and are supported at both ends and in the middle. The ends rest on round posts about a foot in diameter. The posts themselves are tongued into slabs 6 feet long laid transversely to the track. Struts of hard wood hold the posts upright. For the intermediate supports stout slabs are sufficient. In the diagram the dotted lines represent a longitudinal strut put in to keep the track from tilting forwards. On the straight at Byingye one such strut for every 10 posts was found to be ample. On curves, according to their severity, the number of struts should be increased up to a limit of one per post.

To tie the beams together fishplates are required. The holes for them are bored in the middle of the beams, so that they can be easily turned upside down when they show signs of wear.

At Byingye fishplates were not used as the iron rail was sufficient for the tying together of the beams. The rail was of plain flat iron $2'' \times \frac{1}{2}''$ in section with countersunk holes at every two feet. Ordinary wood screws were used for fastening it down to the beams. The upper surface of the rail was slightly convex.

Mr. Shrewsbury's device for sidings or crossings is very simple. One beam of the main line pivots in the middle on a post. A loaded car resting on it can easily be pulled round by a couple of men until the beam comes into line with the side track. Such an arrangement can only be used for single cars. A simple plan for trains of cars would be to pivot the beam from one end instead of in the middle, as shown in the attached diagrams (Plate 6). Two " gates " would be required, one straight and the other curved. The distance between the posts marked A. and B. in the sketch need not be more than enough to give room for the cars to pass, say, 6 feet.

The minimum height of the top of the rail above the ground is 6 feet, with cars as at present designed. It may of course be more than this up to the limits of stability of the posts. The greater the height, the longer the baseboards and struts. In one part of the Byingye track where it crosses a ravine the posts are 20 feet high.

It may be noticed that there is nothing very intricate in the design and that the task of erecting such a track is well within the capabilities of ordinary carpenters. The beams should be carefully sawn and be free from unsoundness. For the rest, in a division such as Pyinmana, it would not be necessary to use any wood otherwise saleable except at purely nominal rates. The "tops" of trees felled for conversion into sleepers would yield plenty of posts, and there are thousands of good slabs to select from, at sawpits in the jungles. Provided that the minimum thickness and width are specified their exact size need not much matter.

A clearing 15 feet wide is quite sufficient for the track. Stumps should be cut down flush with the ground and all big obstacles removed. The ground need not be dressed except where the posts actually come. Having chosen the line and put in pegs at every 18 feet, the running of a line of levels will give the actual

heights of the posts. In practice, however, it would be preferable to cut as many posts as possible to standard lengths of 6, 7, 8 or more feet, and to allow for slight differences in level of the surface of the ground by excavation to a foot or two for the base-boards. When the time came for shifting the track elsewhere more of the posts would then be utilisable.

The behaviour of the cars at Byingye shows that they can very easily ride over considerable irregularities in the upper surface of the rail. As the speed for ordinary forest purposes is not likely to be great, it is not necessary to aim at the mathematical straightness of a permanent railway line. This is worth bearing in mind, so as to make the most use of tree stumps that come in or near the line. They make excellent posts and need no struts to hold them up.

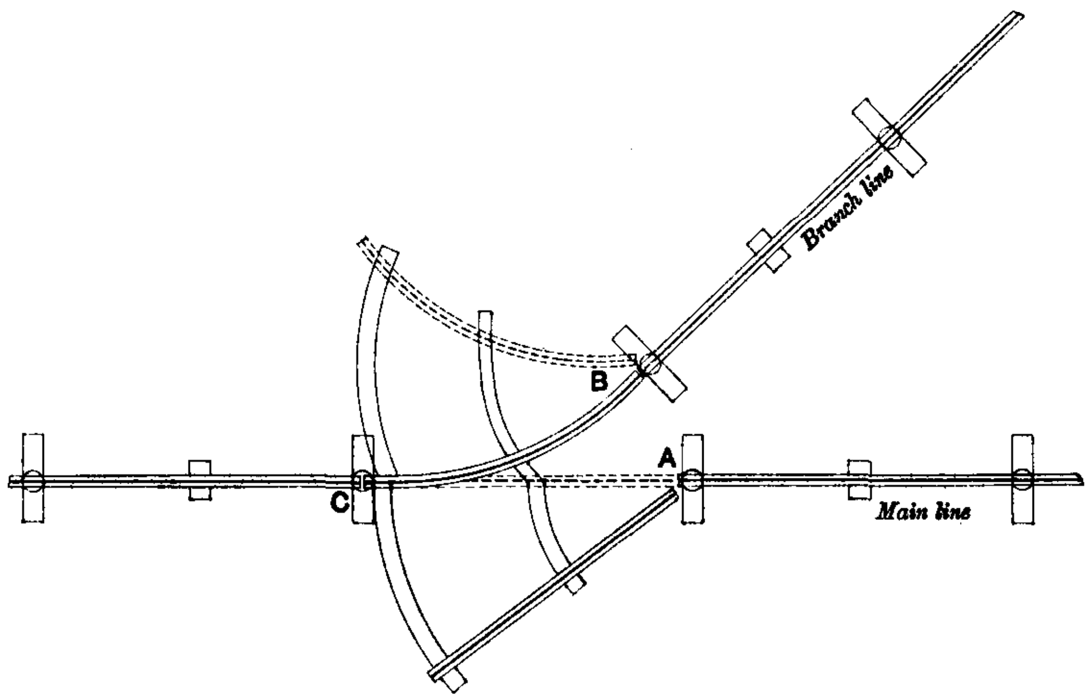
The brake.

When the possibility of using an elevated monorail first occurred to Mr. Shrewsbury, he recognised that one of the prime essentials was a powerful and efficient brake that would be easy to manipulate and not likely to get out of order. The way Mr. Shrewsbury solved this problem is the key to his invention. Instead of applying friction brakes to the wheels, he applied them to the rail itself, and throws the whole weight of the loaded car on to them. The mechanism is as follows. The car wheels are attached to brackets very similar to that of the front wheel of a bicycle, except that, in addition to side movement, the vertical spindles work in movable collars. Each collar is attached to a horizontal lever, the fulcrum of which is fixed to the framework of the car. By depressing the arm of the lever, the car is raised and the whole weight is thrown upon the wheels, which are then free to move. If the lever be released the car promptly drops back on to the rail.

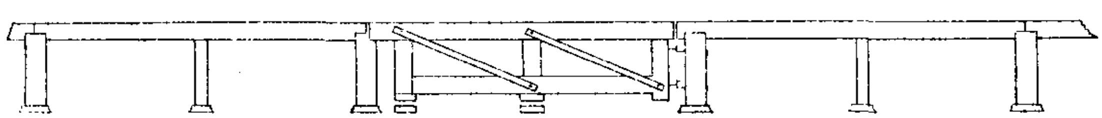
The lever is not directly actuated by hand. A steel rope passes round a two sheaved pulley at the end of the arm of the lever and is connected with geared wheels and a hand wheel fixed at a convenient place in the middle of the car. By means of the gearing, one man can pull round the hand wheel and raise the car off the rail, even when carrying a full load of six tons.

# THE SHREWSBURY MONORAIL

## *"POINTS."*




*Plan (Branch line open.)*



*Side view (Main line open); only one gate shown.*

Photo.-Mechl. and Litho. Dept., Thomason College, Roorkee. Zinco., February, 1911.—No. 7623-I.-325

To apply the brake it is simply necessary to release the hand wheel. If the rope were to snap the effect would be the same, and the car would stop dead within a very short distance. It is hardly necessary to say that the framework of the car is not actually allowed to touch the rail. The weight is really thrown upon a pair of shoes, one at either end of the car. These shoes take all the friction, they cost very little and can easily be replaced when worn out.

When hauling a car a long distance uphill, a small wedge-shaped shoe is hooked on behind the rear wheel, and trails freely on the rail. This simple contrivance effectually keeps the car from running backwards without having to apply the brake, whenever the buffaloes stop, or the hauling rope breaks.

Underneath the car curved iron straps are fixed. When at rest these straps are about a foot from the ground. When they do slide over projecting humps only gentle oscillation is caused, and the car settles down again very quickly. This the writer has seen for himself at Byingye.

Another very valuable use to which the brake mechanism can be put is for loading the cars. If logs have to be carried, all that has to be done is to drag them close to the track in pairs. A car is run over a given pair and the brake applied. This lowers the famework, as already explained. The logs are then tied to the frame. Taking off the brake then lifts the logs and the car is free to move. If the height above ground is not sufficient, it can be increased by repeating the operation as often as desired. After the first lift, place blocks under the log, then release the brake and reclamp the log to the car, and so on.

Haulage.

So far only animal traction of the cars has been thought of. A pair of bullocks or buffaloes can draw a load of 6 tons on the level with ease. One rope is sufficient. There is no need to pull on both sides. The rope can be tied to any convenient part of the framework. For hauling across steep or rocky ravines, a plan found to answer well at Byingye is to carry an extra rope long enough to reach right across the ravine. The bullocks can then scramble across and pull from the other side.

On fairly level ground and with small loads, coolie traction ought to be quite possible. It is used on the Goalpara forest tramway it is believed. The monorail coolie need not stand on the ground. The 6" beams would give him plenty of foothold. If more were required it could easily be provided by fixing small platforms to the car on either side of, and level with, the top of the rail.

For a track built as described in the foregoing paragraphs the timber required per mile would be as follows :—

Cost.

| | | | | |
|---|---|---|---|---|
| Sawn timber—beams | ... | ... | 27 | tons. |
| Do. slabs | ... | ... | 14 | do. |
| Round timber—posts | ... | ... | 24 | do. |

(Posts are assumed to be from 6 to 8 feet long or an average of 7 feet.)

Taking the waste in conversion at 50 per cent and assuming that the slabs from the logs cut up for beams would be sufficient for struts and baseboards, a total of 78 tons of timber in the round would be required per mile. This is a little less than double the amount used on a 2-feet double rail track.

The cost of erection in any particular locality naturally largely depends on the cost of carriage of the materials used. *With timber near at hand*, in the light of the experience gained at Byingye, it is safe to assume that a well made track could be put up any where in Burma for Rs. 2,400 a mile. This figure includes felling, logging and sawing of trees for beams and posts, and carriage of timber from anywhere within a mile of the track. Spikes, bolts and fishplates are included but not an iron rail.

Rupees 2,400 a mile is all that a line would cost a forest contractor or lessee using timber free of royalty. At current rates in Pyinmana the royalty chargeable to an outside firm would be approximately :—

| | | | |
|---|---|---|---|
| For Pyingado | ... | ... | $112 \times 6 = 468$ |
| For Thitya or Ingyin | ... | ... | $112 \times 4 = 312$ |

The iron rail used at Byingye was made by Messrs. Bullivant, London. Landed in the forest it cost the Corporation Rs. 2,166 a mile. This seems very excessive. An ordinary flanged rail would serve pretty well as effectively and would cost far less.

Messrs. Bullivant also made the Byingye cars. They cost Rs. 2,000 each. A Rangoon engineer who saw them expressed the opinion that they could be built in the country for Rs. 700. It allows a fairly large margin of profit, therefore, to suppose that similar cars could be put on the market in any quantity at Rs. 1,000 each if a demand were to arise.

These Bullivant cars are made of steel and angle iron. It is however still to be seen whether locally made cars of wood would not serve equally well and be much cheaper. Mr. Shrewsbury used a wood car with success in Siam, and he is now engaged on the construction of a similar one at Pyinmana. It is estimated that small cars with a carrying capacity of, say, 3 tons could be built for about Rs. 350.

This reducing of the cost of the cars is a step in the right direction. So also is their construction locally. Carpenters and blacksmiths are plentiful in Burma, and it will be a great point in favour of the monorail system if both track and rolling stock can be built and repaired in the forests with the minimum of outlay on expensive materials from abroad.

COMPARISON BETWEEN THE DOUBLE AND MONORAIL SYSTEM.

A detailed and exhaustive comparison between a narrow gauge double line railway and the Shrewsbury monorail is not yet possible as the latter is still in the experimental stage. Moreover it is not yet complete. Animal traction of single cars is all that has been thought of. Once this has made headway, is it safe to assume that an engine to ride astride the rail will not be long in making its appearance. It will then be possible to run the cars in trains, as well as to simplify the designs of the cars themselves.

Although there are doubtless many places where the two systems will compete with each other for favour, yet there will be many other places where the one or the other will have the

advantage. On long leads uphill the double rail has the advantage over the monorail in its present form. Where cross traffic is considerable it may also prove superior, but on long leads down hill or on the level the monorail can certainly make out a good case for itself. If the writer saw any chance of its being sanctioned, he would at once propose the building of a few miles of monorail specially for sleeper extraction in Pyinmana.

Messrs. Macgregor paid Rs. 390 each for their bogie wheeled timber trucks. Monorail cars built of wood are not likely to cost more than this, so that, in comparing the cost of the two systems, it is only necessary to consider the cost of the track itself.

Messrs. Macgregor spent Rs. 24,580 on 6 miles of 2-feet gauge line, or an average of nearly Rs. 4,100 per mile. The sleepers used were cut on the spot, and an unlimited amount more could have been obtained close at hand if required. It is safe therefore to estimate that a monorail (without an iron rail) could have been put up in the same locality at the figure given above, namely, Rs. 2,400 a mile, or a total of 14,400 for 6 miles, a saving of Rs. 10,000.

The difference may very well be expressed by saying 10 miles of monorail costs no more than 6 miles of 2-feet double rail. If royalty on the timber used be taken into account the difference in favour of the monorail is somewhat reduced; but only by about Rs. 350 a mile if valuable timber such as Pyingado is used.

Messrs. Macgregor wish it to be stated that the material for their railway was supplied by Messrs. Orenstein and Koppel, Calcutta.

The following quotations were recently received by the writer from the same firm :—

2-FT. GAUGE TRAMWAY—C. I. F., RANGOON.

| | | | | | Rs. |
|---|---|---|---|---|---|
| Tramway track with steel sleepers, | | 18 lb. rails | ... | ... | 3,800 p. mile. |
| Do. | do. | 14 do. | ... | ... | 3,150 do. |
| Tramway track for wood sleepers | | 18 do. | ... | ... | 3,300 do. |
| Do. | do. | 14 do. | ... | ... | 2,540 do. |

(Fishplates, bolts, nuts, etc., included).

| | | |
|---|---|---|
| | | Rs. |
| Open trucks without brake | ... ... ... | 55 each. |
| Do. with brake | ... ... ... | 89 do. |
| Locomotive with Tender, 20 H. P. | ... .. | 5,650 |
| Do. 30 H. P. | ... ... | 6,250 |

Cost of working.

In the *Indian Forester* for March 1909, Mr. Donald, Deputy Conservator of Forests, gives figures for various kinds of forest tramways existing in India. Two of these lines compare as follows with Messrs. Macgregor's railway :—

| Name. | Length in miles. | Traffic in ton-miles. | Cost per ton-mile. |
|---|---|---|---|
| | | | Rs. a. p. |
| Allapilli Monorail (Caillett's) ... ... | 4 | 4,000 | 1 5 11 |
| Goalpara 2-ft. gauge ... ... | 9½ | 17,000 | 0 4 11 |
| Messrs. MACGREGOR'S 2-FT. GAUGE. | | | |
| First 19 months ... ... | 3 | 6,048 | 31 8 9 |
| Next 8 do. ... ... | 4½ | 6,336 | 1 10 7 |
| Next 4 do. ... ... | 6 | 5,376 | 1 1 7 |

Messrs. Macgregor estimate that the work already done, if it had been done by elephants, would have cost Rs. 4-2-0 per ton-mile. As the locomotive only hauled a very small portion of the outturn given above, it is very probable that the firm is not over-sanguine in estimating that working expenses will soon fall to very little more than twelve annas per ton-mile.

For facility of reference I give below a list of all the papers dealing with extraction of forest produce that I have been able to find in the *Indian Forester* :—

| Volume. | Month. | Year. | Page. | Title. | Author. |
|---|---|---|---|---|---|
| II | Jany. | 1877 | ... | Rough Timber Tramway .. | D. |
| IX | Jany. | 1883 | 44 | Tramways ... ... | F. B. Dickinson. |
| Do. | May | do. | 258 | Tramways ... ... | Deodar. |
| X | Oct. | 1884 | 467 | The New Sledge Road, Deota | Do. |
| XI | May | 1885 | 226 | Project for a new Timber catching Boom at Daghpatthar on the Jumna. | A. G. Hobart Hampden |
| XII | May | 1886 | 197 | A Timber Slide in the Chamba Forests. | W. E. D' A. |

| Volume. | Month. | Year. | Page. | Title. | Author. |
|---|---|---|---|---|---|
| XII | June | 1886 | 244 | Portable Forest Tramways as used in France and Germany. | D. Brandis and Major Bailey. |
| Do. | August | do. | 349 | Portable Forest Tramways: A Decauville's Tramway at Changa Manga. | W. E. D'A. |
| Do. | do. | do. | 367 | Report on the Deota Sledge Road, Jaunsar Divn. | E. McA. Moir. |
| XIV | Dec. | 1888 | 553 | Sleeper Slide .. | F. O. Lemarchand. |
| XV | April | 1889 | 135 | Memorandum on the Timber Export Works in the Bashahr Divn. of the Punjab. | Col. Bailey. |
| Do. | May | do. | 173 | Export Works of the Mandi Forest Co, Punjab. | F. B. |
| Do. | August | do. | 293 | Destruction of the Deota Timber Slide. | E. McA. M. |
| XVI | Jany. | 1890 | 95 | Report on Forest Transport Works in the Salzkammergut, Austria. | A. G. Hobar Hampden. |
| Do. | April | do. | 176 | The Anamallais Tramway. | S. C. M. |
| XIII | Jany. | 1892 | 5 | Sledge Works in France and India. | Q. |
| XIX | Jany. | 1893 | 15 | A Japanese Timber Slide. | R. C. W. |
| Do | Dec. | do. | 452 | A Tour in Jaunsar ... | Hon. Editor. |
| XX | May | 1894 | 180 | Notes on Forest Tram Lines and Wire Ropeways in Germany and Switzerland. | H. L. Porter. |
| XXI | ... | 1895 | Appendix Series. | Wire Rope Slide in the Bruckwald at Interlaken, Switzerland. | A. M. Reuther. |
| XXIII | May | 1897 | 178 | A Forest Railway without Cars. | ( ? ) |
| Do. | do | do. | ... | The Export Works in the Bamsu Forest, Jaunsar Divn. | E. McA. M. |
| XXV | Jany. | 1899 | ... | Wire Ropeway at Mount Stuart. | F. A. L. |
| Do. | May | do. | Appendix Series. | Forest Tramways in the Andamans. | E. M. Buchanan |
| XXVI | Nov. | 1900 | 51 | The Monorail Portable Railway. | E. P. Stebbing. |
| XXVIII | Feby. | 1902 | 69 | Notes on the Setikhola Wire Ropeway | C. G. Rogers. |
| XXX | July | 1904 | 323 | The Long Way round to England. | R. C Milward. |
| XXXII | Sept. | 1906 | 435 | The Goalpara Forest Tramway | W. F. Perree. |
| XXXV | Jany. | 1909 | ... | A Forest Tramway ... | F. Moon. |
| Do. | March | do. | 133 | The Allapilli Monorail ... | J. Donald. |

F. A. LEETE,
*Deputy Conservator of Forests.*
*Pyinmana Division.*

PYINMANA:
*The 5th October* 1910.

## APPENDIX.

*Copies of letters from Messrs. Macgregor and Co., to the Deputy Conservator of Forests, Pyinmana Division, dated Toungoo, the 8th June and 18th July* 1910.

In reply to your Forest Department No. 385/C-260, dated 22nd May 1910, we have the honour to append the following information relating to our light railway in the Yeni Reserve. The information may be used for publication or in any other way you wish.

Regarding the accounts attached, the first capital cost and working accounts apply to a three-mile length of track which was used for 18 months to rail 1,260 logs to Sabein. An extension of $1\frac{1}{2}$ miles was then made, and later a further extension covering the same distance. The $4\frac{1}{2}$-mile track ran for eight months, and the 6-mile track for four months. Separate capital and working accounts are shown.

The main fact to be gathered from the accounts is that the average cost of extraction per log has steadily decreased, while the distance traversed has increased. We have work in this area to make the railway serviceable for some years yet, and beyond an additional three miles of track recently purchased and now being laid down, it will not be necessary to purchase anything of substantial value in that time. Hence the capital cost account will constantly diminish, and with it the amount of capital redeemed, and interest. These in their turn will affect the working account, and reduce the average cost of extraction. We believe we will eventually be able to show the average cost of extraction per ton as Rs. 5.

Comparing the working expenditure with the probable cost were elephants employed, there is a substantial advantage in favour of railing the timber. The railway trucks have carried logs as heavy as 5 tons successfully, and, had elephants been used for this work, no doubt many of the largest and finest logs would have been left behind.

To extract the 2,700 logs shown in the attached accounts in $2\frac{1}{4}$ years, it would have been necessary to employ a herd of 30

elephants. The interest charges on their capital value at Rs. 5,000 each at 6 per cent would come to Rs. 22,500. Taking the mortality amongst elephants at the low estimate of 5 per cent per annum during the whole period, the loss on this score would amount to Rs. 18,750. Adding working expenses Rs. 26,000, and cost of supervision Rs. 6,000, we have a total of Rs. 73,250, or Rs. 35,339 in excess of the expenditure on railing. This difference in favour of the railway will proportionately increase with the outturn.

### *First* 18 *months for* 3 *miles of Track.*

### CAPITAL COST ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To cost of 3 miles of track at Rs. 3,300 per mile ... | 9,900 | By Redemption of Capital, including depreciation, for 18 months at 10 per cent per annum (transferred to Working Account) | 3,423 |
| ,, Cost of sleepers per mile Rs. 2,936 at Re. 0-1-4 each, Rs. 244, 3 miles ... | 732 | Balance ... ... | 19,399 |
| ,, Cost of 14 trucks at Rs. 350 each ... ... ... | 4,900 | | |
| ,, Sundries :—Pumps, jumpers, files, augers, etc., for 18 months | 5,000 | | |
| ,, Cost of clearing ground at Rs. 30 per mile ... ... | 90 | | |
| ,, Cost of laying the line at Rs. 200 per mile ... ... | 600 | | |
| ,, Cost of transport :— | | | |
| 3 miles rails ... | 1,100 | | |
| Trucks ... ... | 500 | | |
| Total ... | 22,822 | Total ... | 22,822 |

### RAILWAY WORKING ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To Redemption of capital including depreciation, brought down .. | 3,423 | By Outturn :— 1,260 logs averaging 80 c. ft., 2,016 tons at Rs. 10-10-3 per ton (Cost per log Rs. 17-7). | 21,477 |
| ,, Interest for 18 months on Rs. 22,822 at 6 per cent per annum ... | 2,054 | | |
| ,, Cost of working for 18 months, | 12,400 | | |
| ,, Cost of supervision do. ... | 3,600 | | |
| Total ... | 21,477 | Total ... | 21,477 |

*Eight months for 4½ miles of Track.*

CAPITAL COST ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To Balance B/F. ... ... | 19,399 | By Redemption of Capital, including depreciation for 8 months at 10 per cent per annum (transferred to Working Account) ... ... | 2,446 |
| ,, Cost of 1½ miles of rails at Rs. 3,300 per mile ... ... | 4,950 | Balance ... .. | 34,244 |
| ,, Cost of sleepers for 1½ miles at Rs. 244 per mile ... | 366 | | |
| ,, Cost of 4 trucks at Rs. 350 each, | 1,400 | | |
| ,, Cost of Engine, plus transport | 7,000 | | |
| ,, Sundries for 8 months ... | 2,500 | | |
| ,, Cost of clearing ground and laying line, 1½ miles at Rs.230 per mile ... ... | 345 | | |
| ,, Transport :— | | | |
| 1½ miles of rails ... | 550 | | |
| 4 trucks ... ... | 180 | | |
| Total ... | 36,690 | Total ... | 36,690 |

RAILWAY WORKING ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To Redemption of capital, including depreciation, B/D ... | 2,446 | By Outturn :— 880 logs averaging 80 c. ft., 1,408 tons at Rs. 7-7-6 per ton | 10,514 |
| ,, Interest for 8 months on Rs. 36,690 ... ... | 1,468 | (Cost per log Rs. 12) | |
| ,, Cost of working for 8 months, | 5,000 | | |
| ,, Cost of supervision do. ... | 1,600 | | |
| Total ... | 10,514 | Total ... | 10,514 |

*Four months for 6 miles of Track.*

CAPITAL COST ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To Balance B/D ... ... | 34,244 | By Redemption of Capital, including depreciation, for 4 months at 10 per cent (transferred to Working Account)... | 1,450 |
| ,, Total charges on 1½ miles of track ... ... | 5,611 | Balance ... ... | 42,035 |
| ,, Cost of 4 trucks at Rs. 350 ... | 1,400 | | |
| ,, Sundries for 4 months ... | 1,500 | | |
| ,, Transport :— Rails ... ... 550, Trucks ... 180 | 730 | | |
| Total ... | 43,485 | Total ... | 43,485 |

## RAILWAY WORKING ACCOUNT.

| | Rs. | | Rs. |
|---|---|---|---|
| To *Redemption of capital, including* depreciation, B/D ... | 1,450 | *By Outturn* :— | |
| ,, Interest *on* Rs. 43,485 for 4 months at 6 per annum | 870 | 560 logs averaging 80 c. ft., 896 tons at Rs. 6-9-9 per ton | 5,920 |
| ,, Cost of working for 4 months | 2,800 | (Cost per log Rs. 10-9-0) | |
| ,, *Cost of supervision* do. ... | 800 | | |
| Total ... | 5,920 | Total ... | 5,920 |

(Sd.) MESSRS. MACGREGOR & CO.

## SOME ASPECTS OF FIRE-PROTECTION IN CHIR FORESTS (PINUS LONGIFOLIA).

It is now over 30 years—it was in 1876 to be exact—that forest conservancy was systematically started in some of the hill forests of Kumaon, and from that date careful and successful fire-protection has been enforced over certain blocks of forest round Naini Tal and Ranikhet. Twenty years later further large chir areas came under the control of the Forest Department and these, too, were all put under fire-protection. Finally, there are still more extensive areas which are not under systematic management, and where the local villager burns at his own sweet will.

There are three distinct zones of chir forest, depending chiefly on the altitude, *i.e.*—

(1) Above 5,500 ft. where the chir forest merges into banj oak (*Quercus incana*) forest.

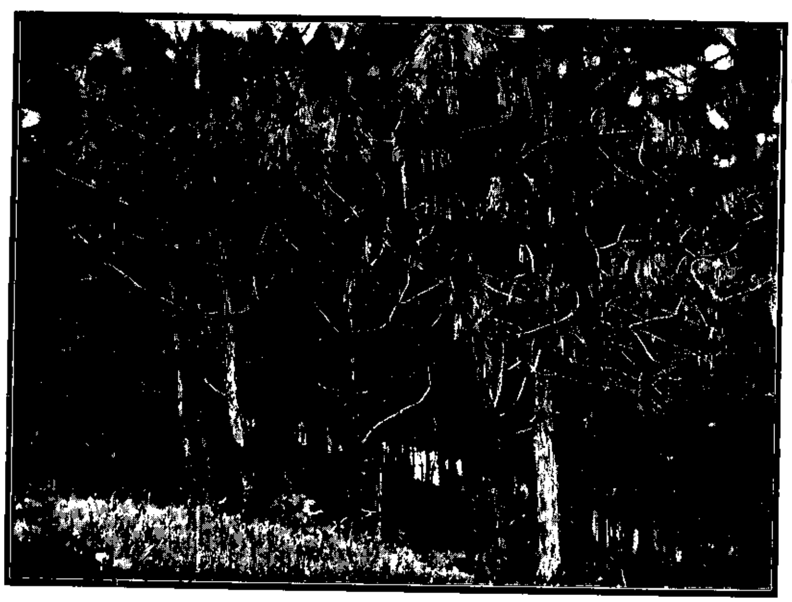
(2) From 3,500 to 5,500 ft. the pure chir zone.

(3) Below 3,500 ft. where chir merges into sal, or miscellaneous scrub growth.

These heights are for a north aspect, and they would be about 500 ft. higher in each case for a south aspect; but no hard and fast lines can be drawn. The effect and relative importance of fire-protection should be considered separately for each zone. In the highest, fire-protection favours the oak far more than the chir in its struggle for existence, and oak may be seen coming up on

I.

Natural regeneration of Pinus longifolia with scattered mother trees without any protection from fire, grazing, etc.



II.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photos. by E. A. Smythies.

Young Pole forest showing successful regeneration combined with fire-burning. Is protection from fire always necessary?

favourable aspects under the chir in all the fire-protected forests. In the Naini Tal Division this is to be encouraged, as the oak is more valuable for fuel and charcoal than the chir, but conditions may be imagined where the oak would be comparatively valueless, and the chir valuable. In the middle zone the chir has nothing to compete with, and with unfavourable conditions, without protection, the area becomes disafforested. In the lowest zone we always find an excessive growth of grass, which is seldom sufficiently kept down by grazing and grass-cutting. This zone is usually found on the steep slopes above the big rivers of Kumaon, and here, fire gives no chance to chir to regenerate itself. There is a superb overmature chir forest near Lohaghat in the Almora district, which is gradually dying of old age while worthless scrub is taking its place, owing to the absence of fire-protection.

We may now consider in more detail the effect of fire and fire-protection in the typical chir zone. As above mentioned we have three classes to consider, *i.e.*—

A. Protected for 35 years.
B. Protected for 12 years.
C. Annually burnt.

and a comparison between these three classes brings out several points of extreme interest.

The comparison, indeed, makes one pause to consider whether fire-protection is the unmixed blessing it appears to be. Of course this is rank heresy, and a year ago I should have laughed at it. Fire-protection may not be necessary in the moist forests of Assam and Burma, but whoever heard of it not being absolutely vital in dry resinous pine forests? I can only reply by drawing the comparison between these classes of forest, and trying to show some of the evidence, which, to my mind, is convincing.

What then are the chief characteristics of these three classes?

In A we are struck by the splendid crop of 30 year old poles, which may be found in large groups throughout the area. In B we are still more struck by the numbers of 5 to 10 year old plants springing up practically universally, *even under fully stocked mature forest.* In C in all areas at all fully stocked there is

practically no regeneration at all except one year old seedlings which are obviously doomed to destruction next hot weather. This seems sufficiently conclusive proof of the enormous advantage, and even absolute necessity of fire-protection for regeneration. I admit the advantage, but even for regeneration it is not absolutely necessary. For instance in B forest we frequently find groups of very fine young poles 20 to 30 years old, which evidently established themselves before the areas were protected. But these are nearly always in groups, of larger or smaller extent.

In C, in absolutely unprotected open forests, regularly burnt every year, with heavy grazing and grass-cutting, I have seen *regeneration as fine as anything we can show in the scientifically* managed, fire-protected, closed-to-grazing areas around Ranikhet. The accompanying photographs (Plate 7) give but a poor idea of an area which I saw in the backwoods of Almora district. There is a big block of forest, certainly over 2,000 acres, where the majority of the big trees have been cut out by villagers, or have fallen down, but scattered groups of mother trees have been left here and there, and the regeneration is simply wonderful throughout the whole block. Such an area is an apparent anomaly, and against all one's preconceived ideas, but it is by no means unique. It is, in fact, quite common to find this splendid regeneration where the trees are healthy and give abundant seed, where the areas are regularly burnt, and there is sufficient grazing to keep down the grass, and where there are gaps of sufficient extent left in the canopy. The explanation is really very simple. In such areas, *forest fires are of the very mildest description, as there is seldom* anything to burn except the yearly mat of shed needles. In dense forests the layer of needles enables the fire to spread to most of the seedlings and kill them.

In gaps however there are no needles, and so some of the seedlings escape.

It might be argued that the absence of regeneration in mature forest and presence thereof in gaps is not due to fire, but to the intense light-demanding nature of the chir pine.

This cannot be altogether the reason, because, in fire-protected areas, the regeneration comes up indiscriminately in the shade or in the open. Chir forests are nearly always comparatively open.

We will now return for a moment to the A class, which have been successfully protected for 35 years. The presence of the 30 year old poles shows that the regeneration came up splendidly when fire-protection started, as it always does; and since then, it must be confessed, that the regeneration has been coming up at a constantly dwindling rate, until at length we have been obliged to resort to artificial sowing in our regeneration coupes, while the final fellings are giving absurdly small yields, as the trees "are not available for sylvicultural reasons." Whether it is that the seedlings cannot get down through the accumulated mat of needles, or whether the ground has become sour, or whether there is any truth in the toxin theory, or whatever the cause is, the fact remains that the powers of regeneration are deteriorating. It is humiliating to confess that after all the prescribed rules of sylviculture have been faithfully followed for years, we should have to utilise artificial means to regenerate the chir, which has such magnificent powers of regeneration in its natural state.

The conclusions which we may draw from the evidence of these three classes of forest are—

(1) that after years of burning, fire-protection gives an extraordinary and universal stimulus to regeneration;

(2) that successful regeneration is possible under the most favourable conditions without fire-protection;

(3) that long continued fire protection has an *adverse* effect on regeneration.

So much for the consequences of fire-protection on regeneration.

I would now turn to another aspect of the case. It is a self-evident fact (and any one who has ever seen a chir forest will bear witness to it) that regular annual burning does absolutely no harm to anything above the seedling and young plant stage. On the other hand a fire in an area which has been protected for some years plays havoc with everything. One can see areas, extending

up to several acres in extent, in which every single tree, large and small, has been killed by a fire. This point, I think, is universally admitted.

It may be argued that even if the annual fires do no apparent harm to the trees, yet the annual burning destroys the humus, impoverishes the ground and will seriously affect the increment.

This would be a strong argument in European forests, where the various species have not become accustomed to growing under the most adverse conditions of soil, moisture, humus, etc., as has the chir. There are cases where the surface soil shows obvious signs of deterioration and denudation, and in such areas fire-protection would undoubtedly be advantageous. But in the vast majority of cases, I should be sorry to see universal fire-protection enforced on this pretext alone.

The fires *may* tend to dry up the ground. The rainfall (of 60″ to 100″) is sufficient to neutralise this. The nitrogen *may* be dissipated into the air: but the chir cannot be very exacting in this particular, when one sees under what conditions it will grow.

If we admit that the physical and chemical conditions of the ground do tend to become worse, in the face of the superb unprotected forests that one finds everywhere, no one could argue that the soil deteriorates to such an extent, as to become unfit for the pine.

We are therefore left on the one hand with an unproved hypothesis of a possible loss of increment, and on the other hand with the undoubted facts of extra work, extra expenditure and above all (as will be discussed hereafter), the very real hardship to the local population.

There is another point to be mentioned in considering the scientific management of chir forest. The uniform method is pre-eminently the best for the managing of these forests. I have mentioned above that the protection of an area from fire, hitherto burnt regularly, induces practically universal regeneration. But who wants universal regeneration in the uniform method? And what is one to do with it when one has got it? Except in the two

first periodic blocks it is a perfect nuisance. Such universal regeneration is abnormal and unnatural, as, in fire burnt areas, regeneration never comes up except in gaps and places where it is wanted. If we allow this regeneration obtained in fire-protected areas to grow up, we shall get an absurd sort of two-storied high forest sufficient to bewilder any future working-plan officer. If we do not allow it to grow up, it is safe to say we shall never get such splendid regeneration again; and it is manifestly impossible to regenerate the whole forest at once. There does not seem to be a single unanswerable reason for anything more than fire-protection of the first two periodic blocks. With the selection system there is no harm in getting regeneration all over the forests, and for this system, therefore, fire-protection would undoubtedly be favourable and useful. But it is only in exceptional cases that the selection system should be used for the chir instead of the uniform method.

There can be no questions that fire-protection was one of the chief causes of discontent, and dislike of the forest conservancy in these hill forests, and, to the villagers, fire-protection will always be a cause of complaint. The grazing deteriorates, the steeper slopes become so slippery with an accumulated mass of needles that the cattle frequently slip and get hurt; ticks and parasites (of sheep especially) become more numerous and therefore do more harm. Again the annual expenditure on fire-protection is no small item, and, of course, brings in no direct revenue. From every point of view then, the advantages of fire-protection should be so obvious, and its necessity so firmly established, that the disadvantages attached to such a policy, *i.e.*, the additional expense and work, and above all the trouble and hardship to the surrounding population, would sink into insignificance.

I have had the opportunity of seeing a hundred thousand acres of fire-protected forests, and double this area of annually burnt forest, and the more one sees of the latter the more one feels convinced that wholesale fire-protecion is not necessary. The only other Forest Officer who has seen the unprotected civil forests of Almora district has left it on record for the future

management of these forests, that "Fire-protection is not necessary and will not be carried out except in the regular regeneration areas, plantations, etc." Other officers who have had experience in the hill forests of the United Provinces have noticed some of the effects of fire-protection briefly described above. I feel perfectly sure that a tour through the chir areas of Kumaon would convince anyone of these facts, and of the more than doubtful advantages of universal fire-protection. It was perfectly natural in the beginning of forest conservancy to insist on fire-protection. All the experience gained in the forests of Europe, all the rules of European sylviculture and forest management, all one's preconceived ideas, demanded it. In France and Germany one saw the damage done by an occasional fire in Scotch pine forests. One can see to-day the damage of occasional fires to chir forests in India, far worse than anything one saw in Europe. But in Europe one never saw the *absence* of damage of *annual* fires combined with grazing. Again, European forests are never so open as to allow regeneration to spring up *everywhere* to the confusion of all scientific methods of working. In short one is forced to the conclusion, after 35 years of fire-protection, that the conditions are so different in these forests that what is a necessity for European forests may prove to be a drawback out here.

I would briefly recapitulate the chief points which I have tried to show in this article.

(1) Annual fires do not do a scrap of damage to anything above the seedling stage. Occasional fires, on the other hand, sometimes kill even the largest trees.

(2) In the typical chir areas as far as regeneration is concerned, fire-protection is very useful, but, when the conditions are favourable, not always necessary.

(3) When fire-protection commences regeneration springs up practically everywhere.

(4) In the uniform method (essentially suited to the chir pine) regeneration is not required everywhere at once, but should be confined to the regeneration areas and to blanks.

(5) There is only one way to do this, namely, protect the regeneration areas and burn the remainder. Blanks would fill up whether protected or not, provided the conditions are not unfavourable.

(6) When once an area has been successfully regenerated it should be carefully burnt early in the year, when fires are not intense, and thereafter fire-protection abandoned.

(7) It is possible that long continued fire-protection causes the power of regeneration of the forest to deteriorate.

(This last point I confess I have mentioned with some diffidence, as it is only based on observations around Ranikhet, where some hitherto unrecognised causes may have been operating. But even if incorrect it would not affect the main argument.

* * * * * *

Are the advantages of *universal* fire-protection so obvious and the necessity so firmly established that all opposition can be satisfactorily silenced? To my mind, at least, the answer to this question seems obvious.

I would not however have my meaning misunderstood. Fire-protection would certainly be advantageous under the following conditions :—

(1) In all regeneration areas.

(2) In all areas where the protection of the soil is of paramount importance. There is no question that a thick mat of needles and grass obtained in fire-protected forests give more efficient protection to the surface soil than the more scanty covering of burnt areas.

(3) In all plantations.

(4) In certain special cases when the crop has become so thin and scattered that it will be advantageous to have regeneration throughout even though the area is not a regular regeneration coupe.

(5) In precipitous areas under the selection system (*i.e.*, most of the areas around Naini Tal).

On the other hand it would be advantageous to abandon, or at least not commence, fire-protection in areas which are fairly fully

stocked (where no danger need be apprehended); where the needs of the people urgently require that areas should be burnt (so far as the burning is compatible with the continued existence of the forests); and in areas which have been successfully regenerated, after the regeneration is safe from fire.

E. A. SMYTHIES,
*Assistant Conservator of Forests.*

*20th January* 1911.

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## THE HYGIENIC TREATMENT OF FOREST TREES.

[*Contributed.*]

With reference to this important subject, an article on which by Mr. S. Morgan was reprinted from the *Fortnightly Review* for June 1910 in the *Indian Forester* for September last, Colonel W. B. Lane, I.M.S., Inspector-General of Prisons, C. P., suggests yet another point which is worthy of consideration. He considers that the use of animal manure for plants may not only be indirectly injurious to man, through spreading disease to the plants, by which it is again spread to the person eating the fruit, but is also directly injurious by tending to increase the number of flies. It is fairly generally admitted to-day that the fly as a carrier of disease germs is very important, anything therefore which tends to increase the number of flies in existence must be harmful. Major F. Smith, D.S.O., R.A.M.C., has already written on this subject in the *Journal of the Royal Army Medical Staff Corps* and has shown by experiments that the two chief breeding grounds of flies are cow-dung and human excrement. In one case no less than 548 flies resulted from one deposit of human excrement. It would seem therefore that Colonel Lane's remark that manure pits are insanitary is fully justified. If the second point be also admitted, *viz.*, that plants actually thrive better when treated with vegetable manures such as leaf mould, it would seem as if our ideas on this subject must be thoroughly reorganised. In that case the system of burning dung which has prevailed in India for centuries has three manifold advantages :—

(1) It provides fuel for the people. (2) It prevents disease being transmitted to plants through the use of unsuitable manures.

(3) It tends to diminish the number of flies which are known to transmit disease in other ways. If to this be added Mr. Morgan's contention that animal manure after being burnt is more valuable even as manure, than before burning, it must be admitted that a very strong case has been made out for his theory. Colonel Lane, although treating the question primarily from the direct sanitary point of view, thoroughly agrees with Mr. Morgan that the proper food of plants is leaf mould and not animal manure, and it will be interesting to hear the views of others who have studied this question. It is one of very great importance in this country, and experiments conducted on both principles should give some most interesting results. They could be carried out at a very small cost, and it is to be hoped that the attention of the Agricultural Department may be turned in this direction, as it would seem quite possible that at present, by endeavouring to prevent the burning of cow-dung, we are doing actual harm instead of good.

# REVIEWS AND TRANSLATIONS.

## AN INTRODUCTION TO BIOLOGY FOR STUDENTS IN INDIA.*

The author of this work is to be congratulated on being the first to bring out a manual for students of biology in Bengal. Captain Lloyd occupies the post of Professor of Biology at the Medical College, Calcutta, and is known to naturalists in India for his work on the racial variations of Indian rats. Previously the appointment was held by Colonel Alcock, F.R.S., who achieved an almost world-wide reputation through his researches on Crustacea and other branches of Marine Zoology. Colonel Alcock laboured under great disadvantages,—Biology occupied but a very meagre position in the preliminary medical curriculum, and there was no laboratory of any description for his students. Remarkable as it may seem, only during the last few years, has it partially come to be recognised in India that, to teach the elementary principles of biology, colleges must secure for themselves properly equipped laboratories. The Medical College, Calcutta, has risen to the occasion, and is providing a good laboratory with a small museum attached, and it is hoped that under Captain Lloyd the teaching of biology will receive a renewed impetus. In few countries of the world are its relations to medicine, and to the general welfare of humanity, closer and more important than in India.

The Indian student of biology is at once confronted with the difficulty that certain of the most important invertebrate types differ very greatly from their nearest representatives described in the European text-books. They are, moreover, classified under quite different genera and families. The present work should do a great deal to remedy this defect, and the author has evidently taken great pains to verify first hand the chief structural features of the types with which it deals. Especially useful to the student should

* By R. E. Lloyd, M.B., D.Sc. (Lond.). Longmans, Green and Co., 1910. With 15 plates of diagrams. Price, Rs. 4.

prove the chapters on *Pheretima* and *Palæmon*. We think however, that the book attempts to cover too much ground within its small compass, but this is perhaps the result of endeavouring to cope with the demand created by the existing Calcutta medical curriculum. If certain of the less important types were omitted, and the remainder treated in greater detail, and with more reference to the physiological aspect of the subject, we think that the student would gain by acquiring a deeper insight into the work. The book is illustrated by a large number of original figures drawn by the author, and the majority serve their purpose well. In some instances, however, especially with regard to *Palæmon*, there is a tendency to spoil the ship for a hap'orth of tar. Certain of the figures are too small, and we must confess to having been considerably puzzled by several of them, notably Fig. K in pl. IX and Fig. J. in pl. X.

The remainder of the book deals with the general principles of biology, including chapters on the theory of evolution, adaptation, variation, and the Mendelian aspect of heredity. In the small space of some eighty pages the author has managed to compress an elementary and thoroughly up-to-date summary of these great questions.

The book is admirably typed, and singularly free from errors, either of description on the part of the author, or of misprinting.

A. D. I.

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## THE MAKING OF SPECIES.*

[*Contributed.*]

It is somewhat late to attempt to review this book, moreover to do so is not easy, since of the reviews that have already appeared some have been by no means favourable. The authors may console themselves with the thought that it would be scarcely possible at the present day to write a book for or against the selection theory, which would not meet with a large amount of hostile criticism, also that in attacking the famous theory they place

* By Douglas Dewar and Frank Finn. John Lane. Price 12*s*. 6*d*. net.

themselves among the progressive party, which is gaining ground rapidly at the present day. Briefly, the book is an expression of discontent with the narrow form of the selection theory as advocated by Wallace and others, a theory which seems to regard the whole problem of existence as already solved, and is inconsequently very displeasing to active minds. The authors' contentions are supported by many original facts and because of these the work has already found a place in biological literature. The work should be of particular interest to naturalists in India, for, as the authors point out, the result of travel and outdoor observation is *doubt*, regarding the theories which appear so plausible in lecture-room and laboratory.

The authors set themselves a severe task in attempting to review the great problems of biology and it is not surprising that they have met with a certain amount of adverse criticism. The account of Mendelism does not appear to be quite clear. It may be doubted as to whether anyone previously unacquainted with the subject could obtain more than a hazy notion of it from a careful study of this book. That which is commonly described as the segregation of characters in the formation of gametesis spoken of by the authors as "a splitting of the gametes in the sexual act." The function of gametes as their name implies is to unite not to split, hence their account of the important discovery made by Mendel is likely to cause confusion.

The book appears to be somewhat unequal in depth. The careful thought that has evidently been bestowed on much of it appears to be wanting here and there. Thus, in speaking of the effects of climate the authors say, "It seems to us that before this check all other checks pale into insignificance. Darwin failed to notice the potent effects of damp. Damp is more injurious to most species than even cold or drought, as everyone who has kept birds in England knows."

The statement that because cage birds are delicate in England therefore damp is injurious to most species is unguarded to say the least of it. There are more individual living things in the sea than there are on land. No one who is acquainted with marine

biology will deny this. Marine creatures cannot be checked by damp. Even in the case of birds it may be doubted whether the authors' contention is true, for the sportsman usually prefers the marsh to the desert. The authors continue, " It is a well known fact that a wet winter in England causes much mortality among rabbits." At the present day however it is no longer safe to say that the rabbits die because of damp. Sheep die sometimes by millions in damp weather because the liver fluke attacks them. In this case damp is bad for sheep and acts as a check but it is wonderfully good for liver fluke.

In spite of these remarks we do not wish to conceal the fact that we are in hearty sympathy with the authors' main contentions. As it is somewhat late to wish the book success, we may conclude by congratulating the authors on the success it has already obtained.

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*Extract.*

"There is in Kunnangai, in Nileshwar beat, a timber merchant, a native of Malabar and a Moplah by caste. He has an elephant of his own and has engaged a number of hired elephants also for dragging timber to the Kunnangai river. In August 1910, I went to the place and I was given the following information :—

Once in a year, a he-goat for each elephant is killed. The flesh is well pounded in a mortar with a pestle. To this is added a mixture called 'Ashta Churnam' consisting of the following ingredients in certain proportions : jeerika, dried ginger, pepper, tailed pepper, rocksalt, a small quantity of opium, etc.

The flesh is then fried in cow's ghee and then preserved in a tin. The above obtained from one he-goat will be given to one elephant in seven consecutive days at evening time. It is placed inside a ball of boiled rice and then given to the elephant. During these seven days the elephants have full rest. After this week for another year, no more flesh is given. No fowls at all are given to the elephants."

## GAME IN THE FORESTS OF EAST AFRICA.

In the course of an exhaustive report by Mr. D. E. Hutchins on the "Forests of British East Africa" (estimated to occupy an area of about two million acres), which has been presented to both Houses of Parliament (published on October 22nd, by Wyman and Sons, Fetter-lane), the author devotes a chapter to game. He remarks that, compared with the abundance of big game on the plains there is but little in the forests. That, however, he urges, is no reason why the game in the forests should not be preserved, especially as there is more chance of effectual protection there than on the plains. In the forests there is more shelter for the game; the forests will not be alienated, but remain Government property; the forests will have the advantage of protection by the forest staff. On the plains, on the contrary, though it is sad to think of, the game (apart from the special game reserves) seems destined to disappear, as it has from the plains of South Africa. When the wonderfully rich grass lands of British East Africa come to be occupied, farmers in defence of their flocks and herds will destroy lions and other carnivora. In many parts of the country sheep farmers must do so. Lions have already been poisoned on a large scale, and during a tour Mr. Hutchins came across poisoned lions and other animals lying dead on the veld. It is difficult, he thinks, to blame the farmers for this destruction. Leopards are destroyed similarly in South Africa.

The animal that is particularly deserving of protection in the forest (continues Mr. Hutchins) is the elephant. It is long-lived but multiplies slowly. It keeps out of the way of men and their works, and is neither dangerous nor destructive to man. Rogue elephants, if they exist, are nothing like so abundant as in the forests of India. The elephant is turned to important uses in working the forests in Burma, and there is every hope that it may be similarly employed on forest work in British East Africa. Its help in getting out the timber is sadly needed. "I have had experience of elephants in the forests of India and of South Africa and am of opinion that the taming of African elephants is a matter of mahouts. I think tame Indian elephants may not be necessary.

With 25,000 Indians in British East Africa, there should be little difficulty in obtaining the services of sufficient mahouts, and I propose, with the assistance of the game ranger, Mr. Percival, to attempt the trapping and taming of some African elephants as soon as more pressing work has been disposed of. I hope to render effective the preservation of elephants in the forests as soon as foresters are located in the forests. (Instructions have already been given to commence building the foresters' houses.) At present the rules against destruction of elephants by native hunters are but partially enforced. My inspections showed that elephant killing by the natives in the Kenia Forest is still in full swing. I came across the dwellings of the Wanderobo hunters in parts of the forest; there was no difficulty in purchasing the poisoned arrows and darts which they employ in killing elephants. They use a vegetable poison, which has an action on the heart and is said to kill an elephant in five minutes. Elephant pits are frequent. During one whole day in Southern Kenia the forest was so thick with elephant pits that no one of our party dared to venture off the beaten paths. Patches of forests are destroyed and burnt over in order to encourage the growth of fresh, succulent herbage. Elephant pits are then dug in the paths leading to these elephant grazing grounds. Ivory is advancing in price, and it is certain that in the absence of a forest staff, elephants in the large forests would become as scarce as they now are in the forests of South Africa. I recommend that the Kenia and other forests, as they become demarcated and placed in charge of a protective staff, should be constituted game preserves and all game within their boundaries placed in charge of the Forest Department. At present the ordinary game license carries a permission to kill two elephants yearly. This permission should be restricted so as to exclude elephants in the large forests, where they are likely later to be turned to use in working the forest. With the elephants will be preserved the other game of the forest—buffalo, the large and rare buck the 'bongo,' water buck, bush buck and various other bucks which frequent the forest glades, but more especially the grass lands above the forests. It is probable that much of the game now on

the plains will take refuge in the forests as the plains become settled and populated. Not the least important use of the forest is the food and shelter it supplies for birds. The bird life of the forest is more varied and abundant than the animals. During my visit more sport was obtained from birds than animals in the forest. The spotted woodpigeon (*Columba arquatrix*) arrived in countless flights, apparently migrating from the Uganda country towards the highlands of British East Africa. This fine wood-pigeon occurs, I understand, as far south as the Transvaal, but always on the highlands. Mr. F. J. Jackson tells me that in British East Africa it is always a bird of passage. Excellent sport, too, was afforded by the crested guinea fowl of the forest (*Guttera pucherani*), and there is no more delicious game bird than this when hung for a few days in the cold climate of the Kenia Forest."—(*The Field*).

# EXTRACTS FROM OFFICIAL PAPERS.

## PUBLICATIONS OF THE FOREST RESEARCH INSTITUTE.

We have received the circular as printed below from the Forest Research Institute, which shows clearly the scope of the Forest publications of that Institute and the procedure enjoined with regard to the same for publication in the *Indian Forester.*

The President also draws our attention to the printed list of establishment of the U. P., especially to the subordinate establishment, and adds "I wish other Provinces would get out lists in this form as it is valuable for purposes of reference, and has been of great value to me personally in tracing the career of past students of the College, which I have had to do for the list of passed students inserted in the College Calendar now under issue." If any other Conservators wish to see how this list is drawn up, we feel sure that either Conservator in the U. P. will supply a copy. It is of great use in the Province.

*Inspector-General of Forests' Circular No. $\frac{13}{298\text{-}3}$, dated 1st December 1910.*

I have the honour to invite a reference to Resolution No. XI of the Board of Forestry, 1910, in which some modifications of the orders in force regarding forest publications are suggested.

Circular No. 3-290-4, dated 13th February 1907.
Circular No. 5-151-1, dated 12th March 1908.
Circular No. 9-260-1, dated 30th May 1908.

2. The existing orders regarding the publication of departmental literature are contained in the marginally noted correspondence. The rules have generally worked satisfactorily but an examination of the suggestions made by the Board of Forestry has indicated the desirability of modifying them and consolidating them into a single set of rules. Advantage has been taken of the opportunity afforded by the recommendations of the Board of Forestry (which have been accepted) to do this, and the publications of the Imperial Forest Research Institute will in future be issued under the following rules.

3. Publication will usually be in the form of Memoirs, Records or Bulletins. All classes of publications will be open to the papers of all authors, whether members of the Forest Department or not, the only condition being that the papers shall have a scientific or economic bearing on Indian Forestry. No papers will be published without the sanction of the Inspector-General of Forests.

4. The Memoirs will be kept strictly technical. They will consist of important monographs containing the results of careful research and of full and original investigations. For example, a memoir may deal with the sylviculture of a particular and important species of tree, such as teak, sal, deodar, or with a family or genus of insect or fungus pest, but not with the description of a new or single species. As years of careful study will probably be necessary before sufficient information is available to justify publication in this form, the number of memoirs issued will necessarily be restricted.

5. The Records will deal strictly with professional matters. They will comprise papers containing, for example, the results of a

full investigation regarding a particular species of insect or fungus, or the results of researches into the formation, growth and economic uses of a particular gum, dye, tannin, etc. The Records will also be suitable for notes regarding preliminary research on any subject, the publication of which may be considered of advantage with a view to facilitating further observations. Notes and observations on such matters as the effects of exceptional seasons on forest growth, the seeding of the valuable species of trees, sudden attacks of serious pests, and generally subjects not considered of sufficient importance to be published as Memoirs will find place in the Records.

6. Owing to the diverse nature of the subjects and material with which forest research has to deal, it has been found that papers of interest and importance are often received which are scarcely suitable for publication either as Memoirs or as Records: such papers will be issued as Bulletins. This series will contain summaries of the progress of observation or research in respect of matters of economic or commercial utility and also tentative publications such as the "Glossary of Indian Forestry Terms." It is important that those interested should be kept informed of the results of practical experience and observation having a direct influence on the improvement and protection of the forests, and to present such information in a form suitable to the use of all branches of the Forest Department will, speaking generally, be the aim and form the scope of the Bulletins.

7. The Memoirs will be published in quarto size 12¼" by 10", the size used by the Royal Asiatic and other Societies and by the Geological Survey of India, etc. The Records and Bulletins will be printed on a page 9¾" by 7½".

8. No definite date for the issue of the various publications will be fixed. They will be issued from time to time as the information available renders this advisable.

9. Each issue, whether Memoir, Record or Bulletin, will consist of a single paper and will include a title-page and an index, unless the latter is considered unnecessary. The Memoirs will be issued in stiff covers and the Records and Bulletins in paper covers.

10. When sufficient parts have been published, the Memoirs and Records will be bound up into volumes containing as a general rule 300—400 pages, excluding plates, with a title-page and a general index for the whole volume. Each Memoir or Record will be separately paged at the top, the entire volume being paged at the bottom, the number being placed in square brackets.

No special orders are required regarding binding the Bulletins.

11. Any or all of the publications may be illustrated by reproductions from photographs or by original drawings. The method of reproduction to be adopted for illustrations will be decided on the merits of each case and may be wood-blocks (for simple line drawings) or the lithographic, half-tone, collotype or photogravure processes.

12. Each Memoir or Record will usually consist of an edition of 600 copies and each Bulletin of an edition of 1,000 copies. The larger number of the Bulletin series (formerly pamphlets) is meant to meet the requirements of English-reading officers of all branches of the Service, the object being to familiarise the members o the Provincial and Subordinate Services with the matter contained in these papers. Requisitions for additional copies of this series should be sent to the Superintendent, Government Printing, India, Calcutta. In special circumstances these numbers may, with the sanction of the Inspector-General of Forests, be increased. The publications will be distributed in accordance with the standing distribution list.

13. The responsibility of the issue of Forest publications rests with the President, Imperial Forest Research Institute, who will either himself conduct all necessary correspondence therewith connected, or depute one of his staff for that purpose.

14. The procedure will be as follows :—

(a) When any person desires to publish a Forest Memoir, Record or Bulletin, he should send the manuscript and illustrations for reproduction direct to the President of the Imperial Forest Research Institute at Dehra Dun, stating his wishes with regard to the form in which it should be published.

(*b*) The President may edit publications to the extent of correcting clerical errors and making minor alterations, but he will not alter the sense or main ideas conveyed in the manuscript. He will not be entitled to use the designation of "Editor" nor will his name appear as such in the publications.

(*c*) The President will transmit the manuscript to the Inspector-General of Forests with his recommendations and the latter will return it to the President with his orders.

(*d*) The President will then take the necessary steps for the publication of the manuscript. The first proof will be forwarded by him to the Author in duplicate for correction. The final proof will be sent to the President for inspection, who may, at his discretion, forward it to the author for final check. It will then be submitted by the President to the Inspector-General of Forests, and with his approval will be printed off.

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## ALTERATION IN THE RULE REGARDING THE EXTRA PENSION TO ALL CONSERVATORS.

The following correction to the Civil Service Regulations, 5th edition, was issued on 1st December 1910. Under Article 475 of the 5th edition which came into effect from 1st April 1910 all Conservators of three years' standing were eligible for the extra pension of Rs. 1,000 per annum. After struggling for years to obtain this concession, it is a severe blow to the department to find that within eight months of obtaining the concession, it has now been withdrawn. We trust that Government will be pleased to reconsider the matter.

*Civil Service Regulations, page* 118, *Article* 475.

Substitute the following for the first fourteen lines of this Article :—

475. Officers holding any of the appointments enumerated below and belonging to what was formerly termed the Uncovenanted

Service, may be allowed by the Local Government an additional pension of Rs. 1,000 a year, provided that they have rendered not less than three years of effective service (that is, service of the same nature as that which, under the provisions of Article 644, counts for the special pensions admissible under Article 642) in such appointment, and provided also that in each case during such service the officer has shown such special energy and efficiency as may be considered deserving of the concession. In the case of officers entering Government service after the 31st December 1909, the grant of the additional pension is subject to the further condition that they must, in the event of voluntary retirement, have completed twenty-eight years of qualifying service. The same rule applies to officers of the Forest Department who entered Government service on or before the 31st December 1909 (including those who were appointed on probation on or before that date), with the exception of those who have, at the time of their retirement, rendered three years' active service in appointments not below the first grade of Conservators. Voluntary retirement for the purpose of this rule should be taken as retirement under Articles 464 and 465.

## MISCELLANEA.

### AERIAL WIRE ROPEWAYS.

An interesting addition to the Forestry Court at the United Provinces Exhibition at Allahabad this year was a small aerial wire ropeway for conveying timber, illustrating a very economical means of conveying materials of all kinds, especially when large quantities have to be transported over difficult country.

The ropeway comprises an endless steel wire rope ⅞" in diameter, which passes round 6¾' horizontal wheels at the two terminal stations, and is supported by three intermediate steel trestles about 20 ft. high, suitably spaced, which carry cross arms bearing sheaves at their extremities, over which the wire rope runs.

One terminal wheel is driven through gearing by an oil engine and the whole rope is thus kept continuously moving round at a speed of 110 yards per minute or about four miles per hour.

The timber carriers are suspended from small trolleys which run on overhead rails at the terminal stations. At regular intervals a loaded carrier is pushed along the rail until it reaches the end, where an automatic clip on the trolley grips the moving wire rope which thus conveys the carrier to the other end of the line. When the carrier reaches the other station the trolly wheels run on to the overhead rail, thus lifting the clip clear of the wire rope. The carrier is then unloaded, run round the rail to the other side of the station, pushed off on to the wire rope again and conveyed back to the loading station.

There is thus a continual string of carriers hung at regular intervals on the moving wire rope ; the loaded ones travelling one way and the empty ones being carried back on the other side.

This ropeway is constructed for conveying billets of wood up to 5 feet in length. The load in each carrier being 6¾ maunds and the distance between carriers being 82½ yards, the capacity of the ropeway is 20 tons per hour. There is an automatic signaller at one station which strikes a gong every 45 seconds and ensures the carriers being sent off at regular intervals.

The automatic clips are extremely simple and very efficient, standing many months of hard wear without needing renewal, and gripping the rope with perfect safety even on gradients as steep as 1 in 2¼.

The wire rope should last from five to ten years before needing renewal, and such other small repairs as have to be made from time to time are quite trifling.

The stations and trestles may be either of wood or steel. The steel trestles are built up of standard lengths about 6 feet long, which are easily transported over any country and bolted together *in situ*.

Any convenient source of power may be used for driving the ropeway. In forests the most economical would probably be a suction gas engine driven by gas generated in a producer consuming wood only.

Such a plant would be very cheap and efficient, and would require less skilled attention than a steam engine and boiler.

Besides the engine attendant, a handy man is required for greasing the trestle wheels, and a foreman in charge of each station with enough coolies to handle the loads. The working costs can thus be kept very low. On a heavy line several miles long conveying material which is easily handled, such as mineral ore, the whole working costs are often less than one anna per ton per mile. The cost depends chiefly on the number of men required to load and unload the carriers.

Wire ropeways are very economical over easy country, but over hilly ground they are without rival, and are in almost universal use in connection with mines in mountainous country in all parts of the world. The trestles are placed on projecting points at irregular intervals according to the nature of the ground, and the ropes can go up and down steep hills and span across wide ravines and traverse almost any kind of country.

The friction of the wheels being very small, it requires only a moderate fall from the loading to the unloading station for the ropeway to be self-acting. In this case a brake is provided to regulate the speed. Only the respective altitudes of the terminal stations need be taken into consideration, the intervening hills or valleys making no difference.

A wire ropeway 3 miles long has recently started running near Murree, conveying about 4 tons of firewood per hour from Patriata Forest to a convenient depôt near the road. The line crosses two deep valleys, one of them with a clear span of 740 yards, and rises and falls more than a thousand feet along the route. The trestles vary in height from 8 ft. to 100 ft. in different parts of the line.

Wire ropeways have been made up to 20 miles long, and for carrying as much as 100 tons per hour; and their length may be increased indefinitely. Carriers are made for conveying almost all kinds of material and even for passengers. Scantlings or heavy logs 30 ft. long or more are slung from a carrier at each end, and smaller material is carried in steel buckets, or in carriers similar to those used on the Exhibition ropeway.

Being particularly suitable for use in forests, it is probable, that they only require to be better known to be largely adopted in this country, as they are in others. The Exhibition ropeway was manufactured by Messrs. Ropeways, Ltd., Eldon St. House, London, E. C.

R. S. UNDERHILL.

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## *ENGLISH FORESTRY ASSOCIATION.*

A meeting was held recently at the Surveyors' Institution for the purpose of forming an English Forestry Association. The objects of the Association are:—

To organise the whole market for English timber and to improve the price, to take practical steps with reference to the production and sale of timber for profit, and especially to initiate steps on co-operative lines for the following purposes:—

1. To improve the price obtained for English timber by—
   - (*a*) keeping a register of buyers and a register of members desirous of selling, so that members can be placed in direct touch with all the best purchasers;
   - (*b*) assisting members to combine in the sale of their timber,
   - (*c*) supplying information as to sources or contracts where a special demand exists for any particular class of timber, and giving the names of districts and purchasers where the best prices can be obtained and large contracts are in operation. Members would also be kept informed of the current prices and demand for any or all kinds of timber;
   - (*d*) encouraging the use of and demand for English timber, and bringing to the notice of buyers the special uses for which it is suitable, and its advantages as compared with other timber;
   - (*e*) encouraging the successful and economical conversion of English timber;
   - (*f*) encouraging local wood industries in suitable districts similar to those at High Wycombe, Stroud Valley and other centres, which ensure a good and constant demand.

2. To reduce the expenses with reference to the production and disposal of English timber by—
   (*a*) initiating co-operative methods and supplying information as to the cheapest and best means of purchasing seedlings, tools, machinery, labour-saving appliances, wire-netting, timber for repairs, fencing, etc., and giving information as to labour and other matters connected with the planting and management of woods, or the disposal of timber;
   (*b*) taking effective steps to secure the reduction of railway rates, and advising how the cost of the transport of timber can be reduced.
3. To take steps on practical lines (in conjunction with any other existing societies where possible) for the encouragement of profitable forestry, and to form a central body to deal with all matters relating to the subject.

Lord Clinton, in moving that the society be formed, said that they had promises of support from owners of woodlands throughout the country representing a great many acres of woodlands. They were anxious to grow the very best timber for practical and commercial purposes, and sell in the best markets. At the present moment it was fair to say that the men who had embarked upon timber growing were not getting the best value for money. In spite of the talk of a timber famine, which had been going on ever since he could remember, prices were not better; in fact, they were worse than ever, and he doubted if any owner could expect to see 2 per cent on his capital outlay. In order to encourage capital it was necessary to ensure that they had a reasonable return. It was not only an improvement in prices that this Association desired to effect—what they suffered from was the prejudice which seemed so widespread against the use of native timber. He was certain that in some classes they could produce as good timber as imported from abroad, and with regard to oak, he believed they could produce better than anyone else, yet it was very rarely that they saw English timber specified in contracts. They had learned a great deal from the accumulated experience of Continental countries

They had learned how to grow timber fit for technical and commercial use, and there was no doubt that with increased scientific and practical knowledge their native-grown timber was better than at any time in the past. At the same time there had been a falling off in the quality of foreign timber. We were now getting trees of a younger growth and immature timber. It would be the duty of the Association to remove the prejudice against English timber in the minds of architects, builders, contractors, railway companies, and other consumers. They had no wish to compete or interfere with any other societies whatever. Their work must begin where the English Arboricultural Society leaves off. There was an idea abroad that they were to engage in buying and selling timber, but their object was not to buy and sell, but to remove those things which were handicapping the industry, and create a healthier and better demand for home-grown wood. Timber merchants might say that the object of the Association was to raise prices; so it was. He would point out, however, that their principal work would be to increase the demand for home-grown timber, and this would surely be to the advantage of the merchant.

The motion was seconded by Colonel E. J. Mostyn.

Mr. G. L. Courthope, M.P., in proposing a resolution that Lord Clinton be the first President of the Association, said that their object was not only to encourage the growth of timber, but also the use of native timber. In addition, a great deal might be done towards encouraging local timber industries. Continuing, Mr. Courthope said: "I want to say a word about the timber trade. I am sorry an idea has got abroad that our movement is in direct opposition to the timber trade. This is not so; anything which succeeds, and we shall succeed, in encouraging the growth and use of timber cannot fail to benefit the timber merchant. Anything which increases the area of woodlands and the demand for timber must be to the advantage of the timber trade."

After Mr. F. G. Burroughes had seconded the resolution that Lord Clinton be made President, the following gentlemen were elected to form the Council:—The Earl of Shaftesbury, the Earl of Chichester, Lord Hastings, Mr. G. L. Courthope, M.P., Mr. Chas,

Bathurst, M.P., Colonel E. J. Mostyn, Mr. S. H. Cowper-Coles, Mr. F. G. Burroughes, Mr. Arthur Arnold, Mr. W. Anker Simmons, and Mr. Gerard H. Morgan.

The election of Mr. Duchesne as Honorary Secretary, on the motion of Lord Hastings and Mr. Arthur Arnold, brought the proceedings to a close.

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## THE FORESTS OF BRITISH EAST AFRICA.

There are, in round numbers, 2,000,000 acres of good timber forest in the British East Africa Protectorate, about 1½ per cent of the total area. Of this timber forest all but 6 per cent is in the highlands, at an elevation of over 5,500 ft. It is entirely under Government control, and is free of destructive rights. The highland forest is extra-tropical in character and differs little from the forest growing at lower elevations in the Transvaal, Natal, and Cape Colony. Under South African conditions, the highland timber forest of British East Africa would have an average value of £10 per acre, and be worth some £20,000,000. The highlands of British East Africa are better watered and more fertile than almost any part of South Africa. It may be safely estimated that if properly worked, the highland forest of British East Africa will have a value exceeding £10 per acre at no distant date.

The chief value of the forest to-day is in the supply of firewood to the Uganda Railway and steamboats, for which purpose it is far more economical than coal—one-third the cost of coal at Mombasa; one-fifth at Nairobi; and about one-seventh at the lake. The forest is fitted also to produce all the sleepers and building timber required by the Uganda Railway, though many of the timbers will require special preparation.

To encourage the use of East Africa timbers in the Protectorate, and to make it possible to export them to South Africa, various adjustments of the present Customs tariff are necessary. To forward the same end, an increased duty on imported timber and corrugated iron is recommended. In view of the importance to the country of an early development of the forests, special rates for the carriage of native timbers on the Uganda Railway are

recommended. South Africa imports at present about $1\frac{1}{2}$ million pounds worth of timber yearly. Vast stores of timber are going yearly to decay in the forests of British East Africa, while the carrying capacity of the Uganda Railway is only partially utilised by its present traffic. A special rate of one farthing per ton-mile is recommended, even though that rate, with the present gauge of the Uganda Railway, means working at a loss. To utilise the timber in the Kenia forest a good wagon road or inexpensive branch railway to a point near Gilgil is required.

The best native timbers are yellow-wood for sleepers and house-building; cedar for sleepers, house-building, furniture, and lead pencils; Ibean camphor as a teak substitute; olive as a first-rate firewood and a second-rate (but very durable) sleeper; iron-wood for house beams, sleepers, and furniture. There are many hardwoods, suited to various uses, some of them of great beauty, strength, and size; two or three very close-grained and good boxwood substitutes.

Teak on the coast, and black wattle and eucalypts on the highlands should be planted as far as funds will allow. The planting of certain areas cut over for the Uganda Railway or the Nairobi saw-mills, and the planting of certain species to introduce them to the forest, are imperative, and cannot be postponed.

There is a slight winter on the highlands of British East Africa. Though situated on the Equator, these highlands are some distance south of the thermal equator. This is of importance with reference to the introduction of many semi-tropical trees, particularly the important forest flora of South Mexico and Central America.

According to the report of Mr. D. E. Hutchins, from which we have culled the above, the sawable timber in South African and East African forests being more scattered than in most European forests, different methods of working become necessary. More slipping is necessary, involving the use of oxen or buffaloes. The oxen of the country are small, but in the hands of skilful bush-workers (like those of Knysna, Cape Colony), could no doubt be turned to useful account. Elephants should also be taught to haul logs. The cost of slipping is reduced by hand-sawing and

local saw-pits. With cheap labour and (at present) dear cattle, local saw-pits seem preferable in British East Africa for all that portion of the forest where the sawable timber is scattered, or for those portions of the forest which are inaccessible and where it will be costly to slip to a saw-mill. The Knysna bush-workers are skilful pit-sawyers. They do an astonishing amount of work in a climate the reverse of bracing. Mr. Hutchins is of opinion that their services for working the forest in British East Africa are desirable. They are mostly white men, and constitute almost the only class of white men doing hard manual labour continuously out of doors in South Africa.

There are at present three saw-mills at work in the forests of British East Africa—(1) Dr. Atkinson's "Equator" Saw Mill ; (2) the Limùru Saw Mill ; (3) the Italian Mission Saw Mill. Mr. Hutchins visited all three, and was pleased with their working and equipment. The first two are on the Uganda Railway. The Limùru mill has been recently established. Dr. Atkinson's mill has been in operation for four or five years. It has lately been re-equipped with a 30 horse-power engine. Three whites, one Indian, and 15 natives were employed. There are circular saws up to 5½ft., and a travelling bench with four vertical saws. The Italian Mission Saw Mill in the Aberdare Forest employs five whites, natives of Northern Italy. They have been there for some years, and afford a convincing proof of the suitability of the equatorial highlands to continuous white manual labour. The mill is worked by two ingenuously contrived water-motors acting with a 10-metre fall of water. The mill comprises machinery for horizontal sawing, planing, mortising, also tongueing and grooving. This mill turns out the timber used at the various branches of the Italian Mission. (*Timber Trades Journal.*)

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## FOREST PROBLEMS OF AMERICA.

### THE WASTAGE IN TIMBER.

Speeches by President Taft, Senator Lodge, Mr. Thomas Nelson Page, and others at the dinner of the American Forestry Association, have again called the attention of the country to the

serious situation which confronts the United States in the matter of her timber-supply. According to the American Forestry Association, the damage done to standing timber by the forest fires of last year amounted to between £35,000,000 and £40,000,000. It is estimated that the area burned over was about 4,000,000 acres, on part of which enough live trees may have been left standing to furnish by seeding the beginnings of new growth, but on much of it the destruction was complete, and the damage to young growth and to soil would materially increase the total loss. How many lives were lost is not, and never will be, known. In the fires in the Bitter Root Mountains, on the Montana and Idaho border, towards the end of August, 76 *employés* of the United States Forest Service, all men temporarily engaged for fire-fighting, were killed, and as many more injured. In the Minnesota fires, of the first and second week of October, it is supposed that about 50 lives were lost, 29 bodies having been recovered. In the whole country it would probably be safe to say that somewhere in the neighbourhood of 300 lives were lost altogether. The Government reports show that in normal years the loss by forest fires is about £10,000,000 in money and 50 lives, the extraordinary destruction last year being due to the unusually dry summer.

In ordinary years the forest officers reckon that the "fire season" in the North-West begins in the latter part of July, but in 1910 there were practically no spring rains, so that the forests were already dangerously dry in the early part of June; and in one district alone of the six into which the Western forest area is divided over 3,000 small fires had been put out by the patrol-men before August 1st, and "over 90 large fires had been brought under control by organized crews of from 25 to 150 men." The Forest Service of the United States Government ordinarily employs something over 3,000 men, of whom 2,500 may be said to be engaged in field work, as supervisors, assistants, rangers, and guards. In the one district mentioned (that which includes the Bitter Root region) over 3,000 extra hands had been taken on by the middle of July; but it was not until, as has been said, towards the end of August that the crisis came.

A FOREST FIRE IN THE MOUNTAINS.

It began on August 20th, and Mr. F. A. Silcox, Assistant Forester of that district, has given a vivid account of what occurred :—

"On the afternoon of that day a hurricane, strong enough in many localities to uproot whole hillsides of timber and force men out of their saddles, swept over the forests adjoining the Montana-Idaho State line. The gale continued for fully 24 hours and fanned every smouldering fire in its path into uncontrollable fury. They flamed up into the crowns of the trees and spread through the adjoining timber, much of which was uprooted before the fires reached it, with incredible rapidity."

"The roar of these fires was heard for miles and was likened by some of the rangers in their path to the noise of a thousand freight trains crossing simultaneously as many steel trestles. At many points these fires jumped rivers a quarter or half a mile wide, and in several instances leaped across canyons a mile or more in width, from ridge to ridge, leaving solid strips of green timber untouched."

"Cinders, ashes, and burning embers were carried many miles. The nearest fire to Missoula, Montana, was about 12 miles, yet cinders as large as robins' eggs fell in the streets, and the clouds of smoke and ashes were so thick, that the electric lights were lit at 3 o'clock in the afternoon. The sun shining through these clouds gave a vivid, lurid glare as of a great conflagration. For many days it shone only as a great round blood-red disk."

It was in the next fortnight, before rains brought relief early in September, that the 76 lives mentioned above were lost. This district probably offers more difficulties to the forest officers than any other in the United States, owing to the extremely rough and mountainous character of the ground and the density of the timber, the windfalls whereof lie crossing each other at all angles upon the ground, the logs in various stages of decay, so as to give only a most treacherous foothold, with thick brush and young growth choking the interstices. The writer happens to be familiar with the region, the character of which can be illustrated by the

statement that some 26 years ago it took him, in company with four other able-bodied men, two days of hard work to cover an estimated distance of eight miles. In such a region the odds are all against the likelihood of the fire-fighters being able to reach a fire before it gains headway: and when they have reached it the odds are overwhelmingly in favour of the fire.

The scene of the other most destructive fire of the year, that of Northern Minnesota in the beginning of October, was comparatively flat; but here, again, the flames were driven by what was described as a "tornado," which began to blow on October 7th: and the awful power which a great fire has, under such circumstances, of leaping wide spaces, as over lakes some hundreds of yards across, without even a momentary check was illustrated at many points. In that fire two considerable villages, those of Baudette and Spooner, were practically wiped out.

THE FOREST IDEA.

It is only within the last few years that the United States has awakened to the necessity of making any effort to preserve its forests, or, indeed, any other of its natural sources of wealth. The National Forestry Association, a public-spirited organization of private persons, was formed about thirty years ago. In 1891 Congress passed a law authorizing the President to establish the reserves now known as national forests; but it was not until 1897 that legislation was enacted which made it possible either to protect the reserves or to make any use of them. Up to that time the American people had proceeded on the assumption that its timber resources were inexhaustible, so that the 850,000,000 acres of forest land, which the territory now embraced in the United States is estimated to have originally contained, are now reduced to about 550,000,000 acres, of which apparently about one-fourth is included in the national forests, while the remaining three-fourths are under private ownership. The value of the national forests is placed at about £400,000,000, and the value of the private properties is presumably at least three times as great—for it may be taken for granted that the tracts which private owners had selected before

the Government began to take action were, at least, not less desirable than those which were passed over.

The United States therefore still possesses a very considerable timber estate, but it is using that estate with characteristic extravagance. The amount cut each year is about three times the amount of the new growth; and the lavishness with which wood is consumed in this country is shown by some figures published by the United States Department of Agriculture, from which it appears that while Germany uses 37 cubic feet per head of the population annually, France 25 feet, and Great Britain 14 feet, the people of the United States use 230 cubic feet.

THE PROCESS OF EXHAUSTION.

The result is seen in the practical denudation of certain formerly heavily-timbered districts, and in the growing scarcity of particular kinds of wood. Thus, one thinks of Michigan as peculiarly a "lumber State"—and in 1880 it did in truth produce 23 per cent. of all the lumber cut in the United States. Now it produces only 4 per cent. How the centre of production has shifted westward is shown by the fact that the North Pacific Coast State of Washington, which in 1880 (when, however, it was a Territory and not a State) produced only one per cent. of the lumber cut in the country, has in each of the last three years been the largest lumber-producing State in the Union. Similarly, the cut of white pine in the Lake States has fallen off 70 per cent. in the last twenty years. In seven years the production of oak lumber in the whole country has decreased by 16 per cent. and that of yellow poplar by 22 per cent.; with the result that the price of oak at the mill has gone up 54 per cent., that of yellow poplar 78 per cent., and that of white pine 53 per cent., while most other woods have appreciated in proportion, thereby contributing their quota to the general increase in the cost of living. Much of this is due to bad methods of cutting and lumbering and to wastefulness in the mills; and meanwhile, owing to neglect and bad forestry, the rate of renewal is so slow, that it is only about one-fourth the average rate per acre in the forests of Germany—and this in spite of the fact that the American trees are naturally of quicker growth. However great,

therefore, the store of timber which the United States may still possess, the situation is obviously one which calls for some reform, and calamitous fires like those of last year can no longer be viewed with the indifference with which similar visitations were regarded a decade or two ago.

WHAT IS BEING DONE.

And reform is under way. The Government Forest Service, which is under the Department of Agriculture, though young, is unquestionably doing good work; but, as has been said, only about one quarter of the present forest area (or, according to one set of official figures, only one-fifth) is owned by the nation. Where private ownership is in large tracts the owners can often be induced to co-operate with the Government, and in some parts of country, as notably in Idaho, Washington, and Oregon, the owners are united in associations which maintain a system of patrol and fire-protection similar, and perhaps not inferior, to that of the Forest Service. Three associations in the States mentioned are said, this last summer, to have spent over £70,000 in fire-protection, one of them having at one time 1,200 men in the field and another 850. But the case is different where large forests are split up among a number of comparatively small owners; and it is there that the danger of fires is the greatest and that the forestry is of the crudest and most wasteful.

Both the Government and the American Forestry Association are working hard to educate the public at large to the urgent need of more economical treatment of the lands and to the commercial wisdom of the insurance in the shape of fire-patrols. It is estimated that while forestry, more or less complete and scientific, is practised on 70 per cent. of the national forests, it is not practised on more than one per cent. of the forests privately owned, and it is officially stated that about one acre in 10 of the privately-owned tracts is burned over each year.

THE GRAVITY OF THE SITUATION.

What the present rate of forest-consumption means is best conveyed by the statement that, vast though the timbered areas in the United States still are, they would, if there were no renewals,

be completely used up in 30 or, at most, 40 years. The renewals by natural growth during that period would extend the time for another decade; but, without artificial renewals, a continuance of the policy of the last generation would see the end of the American timber-supply in less than fifty years, and so far the fruit of artificial renewal has been an almost negligible quantity. The amount of cut-over land replanted in the whole history of the country has been less than one-fifth the consumption of a single year. But, owing to the growth of population, combined with the increase in consuming power of the individual, the annual demand is continually expanding. According to figures published in November by the Census Bureau, the lumber cut of 1909 showed an increase in board feet of 34 per cent. over that of 1908 (when, owing to the general commercial depression, there was a falling off from the previous year) and of more than 10 per cent. over that of 1907, up to that time the largest cut on record. And there is no foreign source of supply to which the country can turn if its own resources are exhausted. It is no wonder, then, that a circular issued by the Forest Service should cry out:—"We are like a growing family which is extravagantly living beyond its income, but which is sure to need an advancing income through future years."

The situation will not, of course, ever be permitted to become as serious as a contemplation of the figures can make it appear on paper. The American people is not really improvident. In ordinary life the man who lives most extravagantly beyond his income is commonly well insured. Hitherto the nation has been thoughtless, with the thoughtlessness of inexperience—like any youth coming suddenly into possession of a fortune of seemingly immeasurable magnitude—but as soon as it comprehends that the fortune is not inexhaustible but that the end is already in sight it has native commercial prudence enough to turn to careful stewardship. The present "boom" in what is known as conservation is evidence that already it is beginning to comprehend; and there is still time to see that the estate is properly "conserved" so that it will always be adequate to the people's needs. But there is no great margin of time to spare.—(*The Times.*)

NOTES.

**The Indian Forest Service.**—The India Office intends to abolish the Indian Forest Professor at Oxford after the year's probationers have finished their training in 1913. Future probationers will be allowed the choice of proceeding to Oxford, Cambridge, Edinburgh or the other Universities if these undertake to fulfil certain conditions including the provision of a suitable curriculum, in consultation with the Director of Indian Forest Studies whom the Secretary of State will shortly appoint on studies, tests and proficiency. The Director of the Forest Service will be appointed for five years and will arrange for the practical training of students, besides lecturing if required.—(*Pioneer*).

**Para Rubber in Burma.**—It is seen from the Reports on the Forest Administration in Burma for the year 1909-10 that Para rubber (*Hevea Brasiliensis*) is reported as growing most successfully in the Bhamo Division and is said to yield rubber freely, and is also doing very well in Myitkyina. The creation in these districts of plantations of this species, as well as of *Ficus elastica*, might engage the attention of those interested in the rubber industry. It seems likely that satisfactory results might be attained especially as the latter species would be growing in practically its natural habitat, and can be tapped at a much earlier age than was at first thought.

**Export of Stag horns from Ceylon.**—By a Proclamation, dated January 17th, the Government of Ceylon prohibit for two years from June 30th 1911, the export for commercial or trade purposes of horns of the spotted deer and sambur.—(*Indian Trade Journal*).

**"Powellised" Timber Sleepers.**—It is believed that the Burma Forest Department have been experimenting with these sleepers and "untreated" sleepers; and that the results have been highly satisfactory, showing the superiority of the Powellised sleeper over the "untreated" timber. Messrs. Killick, Nixon and Company, Bombay, are the representatives in India for the Powell process of preserving timber.—(*Indian Engineering*).

**The New Year's Honours.**—The title of Rai Bahadur has been conferred on Rai Sahib Upendra Nath Kanjilal, Extra Deputy

Conservator of Forests, Eastern Bengal and Assam. We offer him our hearty congratulations.

**Oil from seeds of Prunus eburnea.**—Messrs. Kemp & Co. have tested the seeds of *Prunus eburnea* for oil. They found the yield to be 10 per cent. and the cost about 10 annas per lb. The oil smells strongly of hydrocyanic acid and would not, they state, be suitable as a substitute for almond oil. Oil of peach kernels, imported from Europe, is an efficient substitute and costs in Europe 11 annas per lb.

**Solignum.**—This substance gives great promise as an effective preservative of timber against attacks by insects and fungi, and it will probably prove to be a suitable agent for preserving sleepers. It is stated that it is also an effective preventative against attacks by insects and fungi on living trees and we recommend it for trial especially in fruit gardens.

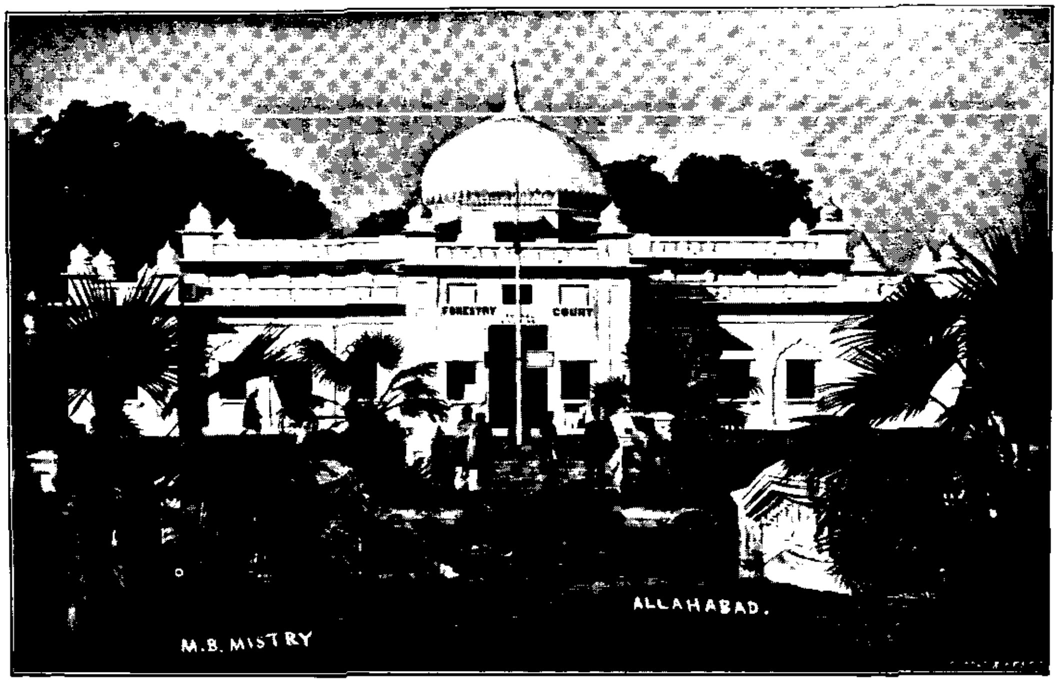


Photo. by M. B. Mistry.

The Forestry Court, U. P. Exhibition, 1910.
The Central Building.

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# INDIAN FORESTER

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## THE INFLUENCE OF FORESTS ON RAINFALL AND FLOODS.

In its issue for the 9th December last, the *Pioneer* published the following article :—

The American scientist often has an irritating way of upsetting beliefs that may have endured for countless centuries among all peoples. For instance, it is popularly believed in India, and in a good many other parts of the globe as well, that forests play a very important part in influencing the amount of rainfall. On the rainfall depends the crops and on the crops depends the purchasing power of the people, so that the question is an all-important one. It is disconcerting, therefore, to be told on the authority of the Chief of the Weather Bureau at Washington that "forests have no effect either upon the amount of rainfall or upon the severity of floods." To many the latter conclusion will come as an astounding statement; and the fact that the Americans are admittedly well ahead in meteorological matters and that the Chief's announcement is based on a solid array of statistics, will bring little consolation to

those who have held strenuously to the belief that forests were the grand protection against floods. The connection between forests and the amount of rainfall is of course a much more doubtful matter, and there must be many who have preferred to keep an open mind on the subject, considering that it is rather probable that forests may flourish because there is heavy rainfall, than that the rainfall increases because of the forests. However, let us look at the facts on which Mr. Moore bases his case. In New Bedford a complete record of rainfall has been kept since 1814 to date. During the last forty or fifty years deforestation in the area concerned has been heavy. During the first fifty years 1814 to 1864—the average annual rainfall was 46 inches; while during the remaining period rainfall has increased to an average fall of over 47 inches. The argument here is that rainfall may do even better without heavy forests. There are other arguments of the same sort and of the same force. Ploughed fields, we are told, will hold water quite as well as the ordinary humus of a forest. As to deforestation causing floods, it is pointed out, *inter alia*, that the Chief of the Hydrographic Bureau of the Austrian Government recently traced the history of the floods of the Danube for eight hundred years, and has concluded that the progressive deforestation of the country has had no effect in increasing the frequency or augmenting the height of the floods. Many other facts bearing on this point are furnished, and Mr. Moore concludes his survey by asserting that in every country the general tendency with the growth of population is to convert forest lands into cultivated fields, and this tendency should not be discouraged unless it can be clearly shown that deforestation has augmented droughts and floods, but he believes that no such case can be shown. He further advises that forests should be preserved for themselves alone, or not at all; and, finally, he says that there can be no valid objection to decreasing the forest area "where homes and a well-fed people take the place of wild animals and wilderness." It would be interesting to know what the Indian Meteorological and Forest Departments have to say to this latest broadside from across the Atlantic.

Referring to this article, a correspondent "M" writes:—

FORESTS AND RAINFALL.

*To the Editor.*

SIR,—The writer of the leaderette which appears in your issue of 9th December, on the connection between forests and rainfall, as interpreted by the Chief of the Weather Bureau of the U. S., has possibly not had the opportunity of studying the series of events which preceded the publication of the report, or of the replies which it elicited. I, on the other hand, have not seen the report, but have only read the extracts and vigorous retorts published in the columns of *American Forestry* by engineering, geological and forestry experts. The whole makes very interesting reading, and those who live for tariff reform and similar many-sided questions and are in need of something new, would be well advised to add this subject to their list, as it is one not likely to be exhausted in their time. The blast of the Weather Chief and the counter-blasts all centre in the political campaign, which has been going on for a considerable time for the acquisition of the more important watersheds of the Appalachian mountains, which are so important a physical feature in the Eastern States of the United States, with funds from the treasury of the Federal Government. It is clear that the other bureaucrats consider that the Weather Chief has played into the hands of the lumberman and the monopolist of water-power. In this particular case the question is mainly to what extent forests induce a uniform humidity and mitigate the physical effects of heavy rainfall on mountains. The other experts, while agreeing generally that the influence of forests in increasing the rainfall is quite problematical, differ from the meteorologist in many of his other conclusions, especially when he minimises the erosion of the hills and silting up of waterways in the plains, following on the denudation of the forests on the higher slopes. To quote from your article "ploughed fields, we are told, will hold water quite as well as the ordinary humus of a forest." Granted that this is so on flat ground, but on a hillside after rain the forest and its humus covering will be retaining their position and

passing excess moisture off slowly while the unterraced ploughed field is scouring and filling the nalas with silt. Again, it would appear that Mr. Moore has boldly entered on the difficult problem of forests *versus* agriculture, an economic problem which experts in those two branches may find it difficult to solve in a densely populated country, but which is nothing but a vote catching cry in the enormous sparsely peopled country of the United States. Altogether, it seems that the Weather Chief travels well outside his own domain and, if the other experts are to be believed, loses his way not a little.

"M."

It may perhaps be of interest if an attempt is made to explain the position as it stands to-day, leaving theory on one side as far as possible and dealing with ascertained facts only. The Government of India have lately held a lengthened enquiry into the effect of forests on the rainfall, the level of the underground water table, the height and duration of floods, as well as into injury caused to the interests of cultivation or to other interests by the destruction of forests, and as a result of this enquiry many interesting facts have come to light.

The American Weather Bureau makes two main statements—

(1) That forests have no effect upon the amount of rainfall.

(2) Similarly, that forests have no effect upon the severity of floods.

and it is concluded that no case can be shown where deforestation has augmented droughts or floods.

As regards (1) there are in India no series of reliable observations carried out over a sufficiently long period to throw much light on the subject.* The Proceedings of the Asiatic Society of Bengal, 1887, Part II, No. 1, contain an interesting article by Blanford. He showed that the only satisfactory evidence would be that obtained by comparing the rainfall of a district when well wooded with that of the same district after deforestation. He endeavoured to apply this principle to the Southern Central Provinces. He

* From information furnished by the Director-General of Observatories in India.

gives evidence that in that area prior to 1875, while five-sixths were nominally under forest, so much damage had been done by *dahya* (*i.e.*, shifting) cultivation that by far the greater part of the forests had become devastated. He quotes the introduction of the Central Provinces Gazetteer of 1870 where Mr. C. Grant says :—

"The tree forests of the Central Provinces have, however, been so much exhausted, mainly owing to the destructive *dahya* system of cultivation practised by the hill tribes that, except in one or two localities, the labours of the Forest Officers will, for many years, be limited to guarding against further damage, and thus allowing the forests to recover themselves by rest. By far the greater part of the uncultivated lands, belonging to Government, are stony wastes, incapable of producing a strong straight growth of timber."

In 1875 the suppression of *dahya* cultivation was taken in hand and with such success that in 1886 Mr. Ribbentrop, then Inspector-General of Forests, wrote :—

"My attention was directed, during a recent visit to the Central Provinces, to the extensive growth of young forests, in areas formerly under shifting cultivation. Ten or fifteen years ago, such temporary cultivation was practised throughout the country and thousands of square miles were thereby laid barren, year after year. Since then, this method of cultivation was stopped, and, though a great part of the area affected was subject to annual fires, a more or less dense forest growth has sprung up."

Blanford then compares the rainfall of the area affected by forest preservation with that away from it ; and shows that while the rainfall in the preserved area, averaging about 50″, was greater by 6·8″ for the period 1876—85 than it had been for the 10 years before, the rainfall in the remainder of the Central Provinces had diminished by 2·9″. Blanford points out that the area in question of nearly 50,000 square miles is large enough to give reliable results, that its history is well known, and considers that the only points on which doubt may be thrown are the reliability of the records and the sufficiency of the periods to yield valid averages. The results of the different stations were so consistent that Blanford

held that the measurements might be trusted, and it would appear that there was an increase of about 9·7″ (or 20 per cent) due to the growth of forest.

There are, as far as we are aware, no other reliable data in India by which the rainfall over a well wooded area can be compared with the same area when deprived of its forests. Observations carried out for a number of years in Ajmer go to show that the rainfall inside the forests is greater than outside, but these observations are not considered reliable. On the whole the general result of the enquiry is that there has been no permanent alteration in the amount and distribution of the rainfall during the past half century either one way or the other. During this period the Government of India have pursued a wise forest policy by which immense areas have been maintained under forest and rescued from impending destruction. The area of forest under the control of the Forest Department to-day stands at 241,774 square miles, and the question may well be put whether India would be getting more or less the same rainfall now as it did 50 years ago if the destruction of the forests had not been checked in time.

This question has received much attention in Europe. In the forest of Haye near Nancy, for example, a series of observations were kept up for 33 years with the result that, taking the rainfall in the centre of the forest as 100 centimetres, the rainfall at the edge was 93·9, and that outside was 76·7 or a decrease of 23·3 per cent. These proportions were ascertained to be independent of the wind direction and the influence of the forests is also independent of the seasons.

The most authoritative work on climatology is perhaps the Hand-book der Klimatologie by Dr. J. Hann. In Volume I, pages 186—193, 1908, will be found a full summary of the results of European and American observations on the influence of forests upon air temperature, ground temperature, humidity, rainfall and the run-off. As regards rainfall he finds that the amount falling inside the forests in Germany is about 3 per cent larger than that outside. In the tropics there is reason to believe that, as shown

by the example of the Central Provinces referred to above, the difference may be considerably greater than this.

At the same time it may at once be admitted that the influence of forests on the total rainfall is in the case of India uncertain, and on the Continent although divergent views are held, it is generally held not to be of any great importance.

In India no doubt the total rainfall depends on the monsoon currents which are affected by the conditions which obtain in the Indian Ocean and sub-equatorial regions. Nevertheless, there is good reason to believe that the rainfall is heavier by perhaps 9 per cent over well wooded districts than it is over similar adjoining districts which have been deprived of their forests.

The next conclusion stated by Professor Moore is that forests have no effect on the severity of floods. This statement has been strongly and adversely criticised by a number of American writers in the pages of *American Forestry*. In the issue of this magazine for February 1910, Mr. John H. Finney, the Secretary of the Appalachian Forest Association, combats Mr. Moore's assertions. He says, in reference to the statement made, that the removal of forests from watersheds does not tend to intensify floods and low waters.

"This is the important point, and it is here that Mr. Moore is farthest afield. The records of his own bureau disprove his assertions. His own words are 'Floods are not of greater frequency and longer duration that formerly.' Disproved by the Monongahela, disproved by the Cumberland, disproved by the Tennessee, the Alabama, the Savannah, the Potomac, the Wateree, and the Congaree. Disproved absolutely by every Southern Appalachian stream whose watershed has in considerable part been deforested by cutting and fire.

"The records for these streams taken from the Weather Bureau are published by the Geological Survey and the Forest Service, and are available to all who desire to see for themselves. Mr. M. O. Leighton, Chief Hydrographer of the Geological Survey, made a most thorough and critical examination of the records of the Weather Bureau for several Southern Appalachian streams,

among them the Ohio, the Allegheny, the Savannah, the Wateree and the Alabama, and reached the conclusion that, to use his own words, 'A broad and comprehensive review of river-discharge records in the United States indicates unmistakably that floods are increasing. It is true that the opposite tendency may be shown on some rivers, while the records for others indicate little or no change; but, taken as a whole, the rivers that reveal more intense flood tendencies so thoroughly dominate the situation that the conclusions above expressed must be inevitable.'

"The Forest Service studied the records from a larger number of streams than the Geological Survey and found 'that in many of the streams in the Appalachian Mountains there had been a steady increase in the number and duration of floods during the past twenty or thirty years,' and that the increase is greatest in the streams where the most forest has been destroyed and least on the streams where forest conditions have been least changed.

"If this is 'false reasoning' or 'mistaken enthusiasm,' let competent authorities judge on the records as they stand, not as they may be presented for the perfectly apparent purpose of supplying ammunition against forest conservation in general and against the Appalachian project in particular."

The issue of the same magazine for April contains articles by Mr. Filibert Roth, Professor of Forestry, by Mr. L. C. Glenn, Professor of Geology, and by Mr. George F. Swain, Professor of Civil Engineering. Each of these scientific authorities hold strongly that forests do very largely affect the violence or otherwise of floods and minimise the destruction caused by them on steep hillsides. These articles show that great destruction of forest has been taking place in the Appalachian forests both by excessive cutting and by fire, that serious erosion of the hillsides has followed this deforestation, and that over many thousands of acres all intermediate stages of erosion, deterioration and destruction can be seen. They show that the river Brazos which flows through open country comes down heavily in flood, whilst the river Wisconsin flowing from the forest will hardly show a rise. That the material eroded from the steep hillsides deprived of their forest

covering is accumulating in the navigable reaches of the rivers below and is seriously affecting navigation. It is stated that there has been a marked increase in the frequency, height and violence of floods in the head-waters of the Southern Appalachians and instances are given. The geological formation of the deposits on the plains below caused by floods show this clearly, inasmuch as it is only in recent years that these deposits consist of coarse sands, cobbles and boulders, whilst those of former time consist of fine rich sandy loam or clay.

In France it has been shown by bitter experience that destruction of forests, particularly in the high hills, is followed by disastrous consequences to the inhabitants and arable lands below. Before the Revolution, there were extensive areas of Crown forests and the nobility also owned extensive wooded estates. The mountainous districts were generally well covered with forests particularly the Alps in the south-east of the country. With the Revolution came the breaking up of most of these estates and a general relaxation of restrictions on the individual with the result that very large areas of forest were destroyed. Mr. Barrington Moore, writing in *American Forestry* for April 1910, says:—

"In France a considerable period elapsed before the effects of this deforestation was felt. But gradually a realisation of the extent of the damage from which the people were suffering was brought home to them. Certain rivers which formed important arteries of commerce were being silted up and were thus choking the commerce dependent upon them, and many prosperous little villages in the mountains were threatened with destruction by overhanging masses of earth and rock. In many cases small streams from these mountains had become intermittent raging torrents carrying down enormous boulders and masses of débris to overwhelm the prosperous communities in the valley, causing not in frequent losses of human life.

"By 1882 * public sentiment had become so strong that a Bill was passed authorising work to be carried on to prevent these

* Other attempts had been made to deal with this question by legislation as by the law of 1860, and again of 1864.

floods, and appropriating $600,000 annually for this purpose. Thus in addition to the incalculable damage already suffered a heavy expense was to be incurred, for it must be remembered that this annual expense would inevitably extend over a considerable period of years. Already at least $17,000,000 have been spent and an enormous amount of work of far reaching benefit to the country as a whole has been done. The French people are now suffering from a mistake for which they were not to blame. They could not foresee, when they inaugurated the idea of giving the individual an absolutely free hand, that the individual would destroy the forests, nor did they know at that time that even if the forests were destroyed such disastrous consequences would follow."

The French Forest Department is still actively engaged in reafforesting the denuded slopes and stopping the torrents formed, and large sums of money are annually expended on these works rendered necessary by the senseless destruction of forest in the past.

For a full account of the damage done by floods and torrents in the high Alps, following on the destruction of forests, of the measures taken, the ruined areas by reafforestation, and of the success obtained, our readers are referred to "L'Etude sur les Torrents des Hautes-Alpes" by Alexandre Surrell.

In India reliable data as to severity of floods in main rivers fed from catchment areas under forest conservation as compared with those in rivers fed from catchment areas which have suffered from deforestation are in the nature of the case practically *nil*, and it seems that nothing short of a series of observations carried out on a river fed from a well wooded catchment area and again on the same river after all the catchment area had been denuded of its forests, could absolutely prove the effect of forests on the severity of floods in the main rivers. The enquiry lately carried out shows on the whole that there is no increase in the severity or duration of floods in most of our main rivers, and here again it may well be asked what would have been the state of affairs had not the Government of India pursued a consistent forest policy

for the past 50 years? It is owing to this policy that a considerable proportion at least of the catchment area of most of our great rivers is well wooded and that the evils following deforestation have been minimised.

If evidence regarding the influence of forests on floods in the main rivers is wanting, or circumstantial only, it is otherwise concerning the floods which occur locally in the catchment areas, and the damage and erosion of the hillsides which surely follow disforestation. It is here that the protective effects of forests and the injuries caused by their removal is most marked and reports from numerous sources show that in India as elsewhere disastrous effects have closely followed disforestation.

Mr. McKenna, the Director-General of Agriculture in Burma, writes :—

"The dry zone of Burma, and particularly Myingyan district affords an excellent example of the evil effects of erosion. The country has the appearance of rolling landscape, the tops of the heights consisting of hard shallow soil (the Kyatti Kon of the Burmese cultivator) which is incapable of producing anything but the poorest crops of sessamum, cotton and jowar. The rainfall is low, but heavy falls suddenly take place and the water which falls, having no chance of being collected and held by humus, rushes down into the hollows, carrying off the soil and breaking up the country by innumerable small waterways. So broken have these lands now become (not to mention that practically only the rock is left) that cultivation on a large and successful scale is impossible. As a general rule, the eroded soil is not deposited at all, but is swept by the smaller torrents into the large waterways, where some damage may be done to crops on the banks. Afterwards it reaches the Irrawaddy and helps to form the sand-banks which imperil and impede navigation on that river and in the long run finds its last resting place in the ocean. 'The oceans are the burying ground of the continents' is one of the maxims of the geologist, but the process can be lengthened and impeded by afforestation, so that the loss to mankind is considerably lessened."

The dry zone of Burma was formerly covered with forest which has now for the most part disappeared.

In the Punjab much damage has been done by erosion caused by floods following disforestation in the outer slopes of the Siwaliks and in the Pabbi Hills. Enquiries made in connection with the Upper Jhelum Canal Works have shown that many of the streams that run off the northern slopes of the Pabbi range of hills, formerly covered with forests but now bare, have scoured out great ravines and channels and cut away much valuable land.

The case of the Hoshiarpur Chos is well known. Here owing to destruction of forest growth and excessive grazing, destructive torrents had formed, and these carried vast deposits of boulders, silt and sand down on to the fields below. These torrents put out of cultivation and rendered useless very extensive areas of land. Following the example of France, a special Act was passed in 1900 providing for protective measures on the hillsides which are now slowly being reafforested. The damage is already reported to be diminishing.

In Bengal extensive denudation has taken place in Chota Nagpur and Orissa, and the consequent damage by floods and erosion is becoming alarming. A Committee has been appointed to examine and report on the question, and have come to the conclusion that the only way to stop the damage is to protect the forests, and as in Hoshiarpur they recommend special legislation for this purpose.

Many similar instances of damage to hillsides by floods and erosion could be given, but enough has perhaps been said to convince our readers that the assertion that deforestation does not augment floods is not in accordance with ascertained facts whether in America, Europe or India.

In a later issue we hope to deal with the influence of forests on drought, and on the low water level of streams.

## TANNING EXTRACTS.

The Report of the Fifth Indian Industrial Conference which met at Lahore on 30th December 1909, contains a useful little paper by Mr. Puran Singh on Indian materials suitable for the *Manufacture of tannin extracts.* The author says :—The imports of tannin extracts into the United Kingdom for the year 1906 were valued at £777,850, while the average for 1897—1901 was only £467,118. The total French production of extracts including that of Corsica reached in 1904 about 105,000 tons, representing a value of about £1,040,000. In the same year France imported 1,841 tons and exported 49,707 tons of the tannin extracts. The German Empire imported 11,005 tons of Querbacho and 27,921 tons of other extracts in the year 1904 and 13,655 tons of the

former and 32,603 tons of the latter in the year 1905. The 617 tanneries of the United States of America consumed in the year 1906, 147,049 tons of the tannin extract (in addition to 1,224,412 tons of tan barks), while in the year 1900, this consumption of the extracts was as low as 14,293 tons only. The increasing tendency of the tanners to use tannin extracts is especially noteworthy in the United Kingdom. This will be apparent from the following quotation from *Capital* of the 23rd April 1908. "In the United Kingdom for 1906, extracts represent $\frac{7}{16}$ of the total import and private advices declare that for 1907, extracts have already exceeded all other agents by over 20 per cent. In America extracts represent $\frac{1}{4}$ of the total production of tanning agents. In Germany for 1906, the proportion of extracts to the whole is a fraction less than 25 per cent., but there are prohibitive conditions attaching to the use of extracts in Germany other than the home-made article, which effectively prevent the cultivation of the improved methods of manufacture or further expansion of the industry."

From the above figures the increasing importance of tannin extract is clear in connection with the hide and leather industry. The demands for bark and wood for extraction made by different tannin extract factories in Europe and America are indeed so enormous that fears are entertained of the shortage at no distant date of the supply of raw materials from the forests that are being indiscriminately massacred to meet the world's demand for tannin extracts. To take an example, in France including Corsica, Italy and Spain, there are 26 tannin extract factories, (this figure is for the year 1903,) with their number daily increasing, which are reported to consume 450,000 metric tons of the chestnut wood. Taking 40 trees to an acre, which yield 150 tons of wood per acre it has been calculated that the consumption of chestnut wood by the abovementioned factories, represents the disappearance of 3,000 acres of chestnut trees annually. In fact at certain places the supply of raw materials is already running short. For instance, it is stated by Messrs. Dumsney and Noyer, the eminent chemical engineers of France, that Corsican deforestation will before long

compel certain tannin factories to engage in the sugar industry (which, it may be noted, can be carried on by the same machinery as is employed for the preparation of tannin extracts), and already beetroot experiments have been organised near Bastia.

CAPITAL REQUIRED FOR STARTING AN EXTRACT FACTORY.

The following estimate of a model extract factory has been based on the calculations of Messrs. Dumsney and Noyer, the eminent chemical engineers of France, for a factory with the necessary plant and equipment capable of treating in 24 hours 60 tons of oak or chestnut wood in Europe or *Acacia catechu*, pynkado and other woods similar in their tannin composition to the European tanning woods. A factory of this capacity is regarded by them as an ideal industrial remunerative concern.

| | | Price. Rs. | a. | p. |
|---|---|---|---|---|
| I. | Battery of 16 wooden vats (capacity 4,400 gallons each) ... | 39,000 | 0 | 0 |
| II. | Two cutters with angular boss, capable of reducing 30 metric tons of wood into chips in 12 hours ... ... | 4,700 | 0 | 0 |
| III. | Two elevators and one conveyer ... ... ... | 3,000 | 0 | 0 |
| IV. | Steam-engine, 50—70 H.-P. ... ... ... | 7,200 | 0 | 0 |
| V. | Boilers, 120 sq., ft. heating surface ... ... ... | 18,000 | 0 | 0 |
| VI. | Two gas generating furnaces ... ... ... | 3,600 | 0 | 0 |
| VII. | Triple effect evaporating plant (capacity 770 gallons evaporated per hour) ... ... ... ... | 48,000 | 0 | 0 |
| VIII. | Four decanting turbines with an output of 220 gallons. (Rebatl, Buffand and Co.'s system) ... ... | 9,600 | 0 | 0 |
| IX. | Factory buildings((including shed, stores) ... ... | 27,000 | 0 | 0 |
| X. | Site for the building with a water-supply of 11,000 gallons per hour ... ... ... .. | 7,200 | 0 | 0 |
| XI. | Water-works ... ... ... ... | 4,800 | 0 | 0 |
| XII. | Five refrigerators ... ... ... ... | 4,800 | 0 | 0 |
| XIII. | Vats for liquors ... ... ... ... | 2,400 | 0 | 0 |
| XIV. | Office and laboratory ... ... .. ... | 1,200 | 0 | 0 |
| XV. | Noyer's condenser-re-heater reservoir ... ... | 2,400 | 0 | 0 |
| XVI. | Shafting and pullies ... ... ... .. | 1,200 | 0 | 0 |
| XVII. | Wood in shade ... ... ... ... | 12,000 | 0 | |
| XVIII. | Incidentals for casks, weighing machines and equipment ... | 2,400 | 0 | 0 |
| | Total ... | 1,98,000 | 0 | 0 |

The estimate given in the foregoing paragraph is for a model factory for the extraction of tanning woods. But materials like myrobolan, mangrove and acacia barks can be extracted with profit even on a much smaller scale, though it goes without saying that the larger the scale of operations, the smaller is always the cost of production. With a capital expenditure of Rs. 50,000 on the plant, an extract factory can be started which should be able to turn out a minimum of one ton of finished extract per day. A rough calculation of the probable cost of production and sale of one hundred weight of mangrove extract may be given here as an example. The cost of the production of 1 cwt. of mangrove extract containing 60 per cent. of tannin, will, under suitable conditions, amount to Rs. 6, while the sale price in England is 15—20*s*. per cwt. (or about Rs. 10—15 at the factory in India or Burma); thus the average gross profit per cwt. works out to about Rs. 5.

Adding another Rs. 50,000 for site buildings and working capital, it may be said that with this investment, 300 tons of mangrove extract can be manufactured in a year of 300 working days. The cost of manufacture calculated on the price of bark, including establishment and other charges, amounts to Rs. 36,000, while the market value would at the rate of Rs. 200 a ton be a sum of Rs. 60,000, thus giving Rs. 24,000 gross profit per year.

The paper includes the following notes on the principal Indian tanning materials:—

I.—Tamaricaceæ:

The galls of three species of Tamarix family, namely, *Tamarix gallica*, Linn., *T. articulata*, Vahl., *T. dioica*, Roxb., contain about 50 per cent of tannic acid, being therefore, as valuable as the oak galls. A sample of the bark gave about 8 per cent of tannin and 19 per cent of total extract. It is evident, therefore, that both the bark and the galls of these species can be very profitably utilised for the manufacture of tanning extract.

II.—Dipterocarpaceæ:

*D. tuberculatus.*—In 1898, an extract was prepared from the bark of *D. tuberculatus* in Burma, and it gave 24 per cent of

soluble tannin. It may be noted here that this bark is capable of yielding a much richer extract if prepared on scientific lines. The method of preparing the above extract was evidently very rough, and much of the tannin was lost by heating in open air.

*Shorea robusta or sal bark.*—This bark is a valuable tanning material, though till now it has been very little used. Large quantities of this bark can be had as waste product from the forests of United Provinces and Bengal, which can be profitably turned into extract, if due attention is paid to the systematic collection and transport of the bark to a centrally situated factory. The bark of the old sal trees yields 8–9 per cent of the extract and the young sal bark about 14—20 per cent. The tannin calculated on the dry bark is in the case of the former 5 per cent and in the case of the latter 9—12 per cent.

The extracts experimentally prepared from this bark, as examined by Professor Dunstan of the Imperial Institute, London, gave only 21 per cent of tannin. Here, again, the conditions of preparation of small quantities of tannin extract are to be blamed for this low value. In the opinion of the writer, the extract from the sal bark under proper conditions can be concentrated to yield 40—50 per cent of tannin. Professor Dunstan, remarking on the above-mentioned results recorded in his report, indicates the possibility of preparing this extract which when employed as a tanning agent furnishes leather of good texture and colour.

*Veteria indica.*—The fruit of this species gives tanning extracts of fairly light colour. As analysed by Dr. Leather, the fruits gave 25 per cent of tannin with only 12 per cent of soluble non-tannin.

III.—Sterculiaceæ :

*Heritiera littoralis*, Dryand.—The bark from this tree is reported to be remarkably free from any objectionable colouring matter and has 14 per cent of tannin in it.

IV.—Anacardiaceæ :

*Odina Wodier.*—The bark of this tree has 9 per cent of tannin.

*Mangifera indica* has 16 per cent of tannin.

*Pistacia integerrima.*—The galls of this tree, known in vernacular as *Kakra singi*, contain as much as 75 per cent of tannin in them. They may be said to be nature's concentrated extract of tannin, and are very useful in preparing mixed tannin extracts.

*Rhus paniculata*, Wall.—The bark of this tree as examined in the Economic Laboratory of the Indian Museum, Calcutta, gave about 22 per cent of tannin, while an extract prepared from the bark contained 82 per cent of tannin. This percentage seems to be too high, but assuming that the average percentage of tannin in the extract is 60—70, it will be seen that an extract of such a concentration can easily realise high prices in the European market.

V.—Coriariaceæ :

*Coriaria nepalensis*, Wall.—All parts of this plant are said to be rich in tannin. The leaves contain 20 per cent of tannin, and it will be interesting to experiment with their extract as a tanning agent.

VI.—Leguminosæ :

*Acacia arabica*, Willd.—The bark of *Acacia arabica* is one of the most popular tanning agents in this country. It gives almost as good a leather as the famous wattle bark of Australia. One tannery alone of Messrs. Cooper, Allen Co., Cawnpore, consumes 500 maunds of this bark every day. The bark contains about 17 per cent of tannin and 6 per cent of soluble non-tannin. The pods of babul are said to contain varying quantities of tannin from 5—20 per cent according to their age, the younger ones being richer than the mature ones.

The extracts prepared roughly on a small scale from the bark and the pods of babul gave 30 per cent and 23 per cent of tannin, respectively.

*Acacia Catechu.*—This is the famous *Katha*-yielding tree. Both the bark and the wood of the tree can be utilised for manufacturing tannin extracts. From the wood they prepare *katha* in

certain localities which is sold locally for edible purposes. Simultaneously with the manufacture of *katha*, the writer is of opinion that a good light-coloured tannin extract can be prepared as a by-product from the wood, but the operations will have to be carried on a much larger scale than is at present done, with up-to-date machinery. Under proper conditions a product almost like Gambier, a tanning material much in demand, can be prepared from this tree.

The bark of the tree is also capable of yielding a good tannin extract.

The tannin extracts from *Acacia Catechu* can be easily concentrated to yield 60—70 per cent of tannin.

*Acacia leucophlœa.*—The bark of this tree contains 21 per cent of tannin and is reported to be as good a tanning agent as the babul bark. The wood of this tree may possibly be of use for wood-pulp,* in which case the bark will be a waste product and available for the extraction of tannin.

*Caesalpinia coriaria*, Willd.—This is the American sumac or dividivi. It was introduced in India in 1834, and it has been cultivated in many districts of India with considerable success. The pods from this Indian-grown dividivi give 30—50 per cent of tannin.

*Caesalpinia digyna*, Rottl.—This is an indigenous species of dividivi growing freely in Burma, Assam and Bengal. It can be cultivated with great ease. The pods from which the seeds have been removed show over 50 per cent of tannin, and in certain samples the percentage rises as high as 60. This may be regarded as pre-eminently a ready made tannin extract manufactured in the great laboratory of nature. A chemical examination of these pods was made at the Imperial Institute, London, and the results of chemical analysis were confirmed by practical trials of the extract prepared from the pods in the tanyard. As a result of this investigation, Professor Dunstan considers the pods of *Caesalpinia digyna* of India to be one of the richest tanning agents possessing properties of special value which render it of more importance than the South American dividivi.

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* This is not probable.—HON. ED.

*Cassia auriculata*, Linn.—The bark of this species known as *tawar* in C. P. and *tangadu* in Southern India is a valuable tanning material which, according to Mr. Hooper, contains 11 per cent in the bark from young trees and 20 per cent in that of the mature trees.

*Xylia dolabriformis*, Benth.—This is the famous pynkado of Burma, Bombay and other places. A large quantity of pynkado timber refuse or dust is available and may form a useful source of tannin. The specimens of sawdust and chips of pynkado gave 6 and 5 per cent of tannin, respectively. An extract prepared experimentally at Pyinmana according to the analysis of Professor Procter contained 32 per cent of tannin and 58 per cent of water. With regard to its tanning properties Professor Procter reports: "In its low percentage of soluble non-tannin as well as in colour it resembles querbacho. It might become a very useful tanning material. . . . . A sample of leather tanned in one per cent solution is reddish, but not more so than querbacho or mimosa."

To have drawn such a favourable report from Professor Procter for an extract not prepared under the best conditions for making a good extract shows the high economic value of pynkado dust or refuse as a starting material for making tannin extracts.

VII.—Rhizophoraceæ (The Mangrove Family):

The species of this family are by far the most abundant and richest tannin-yielding trees. As mentioned above, a large factory has been recently established in Borneo for the preparation of extracts from mangrove barks. The efforts of the Government of Burma are also concentrated on the production of extracts from mangrove. So far the extracts yielded by *Rhizophora mucronata*, Lamk, have proved to be the richest tannin extract in the market. The only objection that is made to them by the tanner is their being of too red a colour and their imparting an objectionable purple violet colour to the leather. But the objectionable colouring matter in these extracts may be found capable of elimination. Further, just as the dark-coloured extract of querbacho and palmetto

are advantageously utilised in Europe in mixed processes of tanning, it appears possible that a judicious mixing of the red-coloured extracts of mangrove with light-coloured extracts is capable of yielding satisfactory results. Another advantage of suitably prepared mangrove extracts is that their active substances are quickly absorbable by the hides, and the tanning can be effected with very weak liquors; further, there is no necessity to increase the strength of the liquors in the final stages of the tanning process as has to be done in the case of other vegetable extracts. The high amount of tannin in mangrove extracts is a great recommendation in their favour, and the tanner is already beginning to see his way of utilising them to his best advantage. In fact, Borneo cutch has taken the market already and is being sold at 15—20 shillings per cwt. For the reasons stated above there seems no reason why the Indian mangrove extracts should not similarly find a ready sale.

The bark of the *R. mucronta* contains 26—30 per cent of tannin, and the extracts prepared from the same have 72 per cent of tannin with a water content of about 16 per cent. The Rangoon extract is richer in tannin than even the Borneo cutch. Experiments instituted by the Imperial Forest Research Institute, Dehra Dun, at the instance of the Government of Burma for the production of different grades of mangrove tannin extracts are in progress, and efforts are being made to put them in the European market. In this connection, however, it must be remembered that until the Indian mangrove extract becomes well known among tanners, it is not likely to fetch its full commercial value. Its introduction in the market can only be affected, therefore, by the aid of capable and influential agents.

VIII.—Combretaceæ:

Next to the mangrove family, the various species of *Terminalia* deserve a short description.

*Terminalia Chebula.*—This tree is distributed in many parts of India and Burma. The fruits known as *harra* are collected largely in Central Provinces, both in the Government and malgu-

zari forests, and exported to Europe. Dr. Leather gives the following results of his analyses of four different samples :—

| | Extract per cent. | Tannin. per cent. |
|---|---|---|
| Madras ... ... ... ... ... | 57·87 | 38·67 |
| Bombay ... ... ... ... ... | 59·47 | 40·80 |
| United Provinces ... ... ... ... | 59·47 | 43·74 |
| Central Provinces ... ... ... ... | ... | 31·00 |

The fruits are now mostly exported as they are, but with suitable appliances, very good pale-coloured extracts can be made, thus increasing many times the present price of this raw material. It is a matter of some satisfaction that one tannin factory at Raneeganj is already turning out marketable extracts of these fruits. Similar concerns should be started in different parts of the country on the same lines.

Mr. Hooper makes a valuable suggestion that even the bark of this tree can form quite as good a tanning agent as the fruits.

This will be apparent from his following analyses :—

| | Extract per cent. | Tannin per cent. |
|---|---|---|
| Bark from young tree ... ... ... | 45·8 | 34·9 |
| Do. do. mature tree ... ... ... | 35·7 | 33·0 |
| Do. do. old tree ... ... ... | 31·2 | 27·5 |

*Terminalia Oliveri*, Brandis.—According to Professor Procter the bark of this tree known as *than* in Burma contains 31 per cent of tannin, while its leaves show about 15 per cent. An extract made from the bark as examined at the Imperial Institute, London, gave 68 per cent of tannin. The writer has also found this material to yield an excellent extract, and the latter *may find a ready sale* in Europe at remunerative prices, if the supply is adequate.

*Terminalia tomentosa*, Bedd.—The bark of this tree has been on different occasions tried for experimental extract-making. It may be regarded to be quite as good as the *sal* bark. It is reported to impart an objectionable dark colour to the leather, which can be eliminated when it is extracted on a large scale.

IX.—Myricaceæ:

*Myrica Nagi*, Thun.—The bark of this tree, known as *kaiphal* in Hindi, has 27 per cent tannin in it according to the analysis of Professor Procter. With such a high percentage of tannin in the bark, it will be an excellent material for extract manufacture, provided the supply requisite for the purpose may be forthcoming.

X.—Cupuliferæ:

Of the *Quercus* species, Professor Trimble examined four samples of oak bark from India with the following results:—

| | | | | | Tannin on dry bark. |
|---|---|---|---|---|---|
| *Q. glauca*, Thunb | ... | ... | ... | ... | 12·20 |
| *Q. dilatata*, Lindel | ... | ... | ... | ... | 7·94 |
| *Q. incana*, Roxb | ... | ... | ... | ... | 23·36 |
| *Q. semecarpifolia*, Sm | ... | ... | ... | ... | 8·60 |

The tannin in these four barks is said to be identical with that of British and American oaks.

XI.—Coniferæ:

*Pinus longifolia*, Roxb.—The bark of the chir pine is used in various hills of India for tanning purposes. The percentage of tannin in the bark is about 13. As pine-bark extract is used in Europe, together with chestnut and querbacho extract, it will not be a bad idea to mix chir pine bark with other heavy-coloured materials for making mixed extracts.

From the description of the various Indian tanning materials given above, a fairly correct idea can be formed as to the tannin resources of India and as to the extent this country may take in supplying the tannin extract demand of the world. It will be seen that many of these materials compare very favourably with the raw materials of Europe and America in the percentage of tannin, and in most cases our materials are much richer.* When the European capitalist thinks it worth while to extract woods and barks containing 3·4 per cent of tannin, there is no reason why the pioneer manufacturers of India should not be able to

develop a well-organised and flourishing tannin extract industry in this country with great profit to themselves and to the people. Only proper organisation and a fair amount of enterprise are required in this direction, and difficulties in the supply of raw materials will probably be overcome since the Government is always ready to extend careful and sympathetic consideration to the development of this important industry.

It may be added, however, that the Leeds Chamber of Commerce expresses the opinion that it would be desirable to confine the manufacture of extracts to materials that contain only a small percentage of tannin. For instance, if two tons of myrabolans be extracted and concentrated into one ton, the freight on one ton would be saved ; but the cost of extraction and concentration might amount to more than the saving obtained.—(*Indian Trade Journal.*)

# ORIGINAL ARTICLES.

## PAPER-PULP TESTING AT THE FORESTRY COURT CELLULOSE LABORATORY, ALLAHABAD EXHIBITION.—PART II, WOODS.

BY W. RAITT.

Much of the practice of the art of dyeing is founded on the fact that cellulose whether as paper, or in the form of a woven fabric as calico or linen has a great affinity for certain groups of colour compounds, precipitating them upon itself or filtering them out of their solutions. One of the objects of the pulp maker, in the earlier stages of the manufacture, is to prevent this occurring, otherwise an unbleachable pulp may be the result. The soda process does, in the case of some materials, produce dark coloured compounds during digestion which fix themselves on the pulp, degrading it to a partially or wholly unbleachable condition. *Salix tetrasperma* and, in a lesser degree, *Trewia nudiflora* proved to be marked examples of this, and in general, the difficulty with most of these low country woods appeared to be that of either

preventing the formation of such colours or of producing them in a permanently soluble form, capable of being completely washed out of the pulp.

A sample of unbleachable *Salix tetrasperma* soda pulp, repeatedly washed with hot water until the wash water flowed away perfectly clear and bright, was steeped for fifteen minutes in a weak (two per cent) hot solution of sodium sulphide. The result was a dark brown liquid nearly as dark as the original soda liquor from the digester, the colouration of which remained soluble and was easily washed out of the pulp, leaving the latter several shades lighter in colour and easily bleachable, in other words, the sodium sulphide had reduced the precipitated colours to a permanently soluble condition.

Now the distinguishing feature of the sulphate process is that it combines the *reducing* action of sodium sulphide with the oxydizing and hydrolysing action of sodium hydrate (caustic soda), and, as the above experiment showed that the objectionable colours were reducible, the sulphate method of digestion seemed to be clearly indicated. Before deciding to follow it up it was necessary to give some consideration to the rival method of digestion by the *sulphite* process, which does its work by sulphur dioxide, partly in solution and partly in combination with lime as calcium bisulphite. It does undoubtedly give good results with *coniferous* pulps, not only in quality and colour of product but in economy also, though the latter is less in comparison with sulphate than with soda ; but it is doubtful whether it would give equally good results, so far as colour is concerned, with the class of woods now under consideration. In the case of bamboo, which presents a colour difficulty similar to the one we are now dealing with (both, it will be noted, being low country, tropical products), the results have not been quite satisfactory, as attested by the experiments of Richmond (American Bureau of Science, Manila), Coventry (Forest Institute, Dehra Dun), and ourselves. Then it is doubtful whether the sulphite process is practicable in a tropical country without the aid of a system of refrigeration which would seriously discount its economy. Its success depends mainly on

the absorption by water, or lime water, of sulphur dioxide gas, an operation which is considerably handicapped by any increase in the temperatures of both water and atmosphere over those normal in temperate latitudes. On the whole, the balance inclined in favour of sulphate, so it was resolved to follow this up, leaving sulphite to be enquired into on a future occasion.

The success of sulphate digestion depends largely on obtaining the proper balance or proportion between the two chief constituents of the liquor, and a series of preliminary trials were necessary to arrive at this. It may vary considerably for different classes of material. Ultimately a proportion of 6 of hydrate to 2½ of sulphide appeared to give the best results with these woods. For want of time, no attempt was made to fix the minimum *quantities* necessary. These would certainly vary in each case and will have to be subsequently determined. The present object was to solve the colour problem of a whole *class* of woods showing similar characteristics as regards colour, and which could apparently be dealt with by liquor containing hydrate and sulphide in the above proportions. The quantities required will probably differ with each individual of the class but the proportions not ; so all that was necessary was to secure a standard liquor of sufficient density to ensure reduction of the most difficult of the species selected for trial. After the *class* problem has been solved, it will be comparatively easy to work downwards from this maximum density in order to settle the requirements of each individual.

From the pulps scheduled as second class in quality, a selection had to be made of those which best combined the commercial requirements of quality of product with abundance and cheapness of raw material. Having regard mainly to the Tarai districts of the United Provinces, Mr. Clutterbuck selected *Bombax malabaricum*, *Salix tetrasperma* and *Trewia nudiflora* as those best fulfilling the latter considerations. The selection is a fortunate one from the other point of view for these also happen to be among the best of their section in quality and yield. The coniferous pulps, scheduled as first class, were for the present set aside as it is already known that they behave well under sulphate treatment.

These three were first submitted to analysis, after being reduced to an air-dry condition, with the following results :—

| | Bombax malabaricum. | Salix tetrasperma. | Trewia nudiflora. |
|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* |
| Hygroscopic moisture ... | 9·26 | 11·38 | 12·7 |
| The following on the dry sample. | | | |
| (*a*) Water extract *tannin, gum, mucillages.* | 5·10 | 4·75 | 4·00 |
| (*b*) Alcohol and benzine extract—Rosin, oil, wax. | 2·90 | 2·90 | 3·00 |
| (*c*) Hydrolysis by treatment for 1 hour in 1 per cent. boiling sodium hydrate. | 13·30 | 8·00 | 8·50 |
| (*d*) Ash ... ... ... | 2·60 | 1·00 | 2·30 |
| (*e*) Cellulose ... ... | 49·00 | 53·20 | 52·00 |
| (*f*) Lignin, by difference ... | 27·10 | 30·15 | 30·20 |
| | 100·00 | 100·00 | 100·00 |
| Total *to be removed by chemical action, viz.*, (*b*), (*c*), (*d*) and (*f*). | 45·90 | 42·05 | 44·00 |

The loss by hydrolysis (*c*) was determined after exhaustion by (*a*) and (*b*) and may be taken to cover pectous matter and the weaker forms of cellulose which, under any method of treatment, would be lost by being hydrolysed into soluble matter. The larger amount of this in *Bombax* coupled with the smaller quantity of lignin, would indicate that this wood can probably be successfully treated with weaker liquor than the other two.

A sulphate liquor was now prepared containing hydrate and sulphide in the previously mentioned proportions and also small quantities of carbonate, sulphite, and sulphate of soda in the

proportions usually found in factory liquor prepared by aid of a recovery plant. This was done in order to work as closely as possible to factory conditions. The two first however, are insufficient in amount to have any appreciable effect on the operation, while the sulphate remains quite inert. The total strength of the liquor expressed as alkali ($Na_2O$) was 7·4 per cent, which would include all but the sulphate. The density was 19° by Twaddles' hydrometer, and sufficient liquor was used to just cover the material after it had been well tamped down in the digester. Although the same liquor was used for each of the three, the minor points of duration, temperature and pressure, were varied in each case in accordance with their behaviour as observed in preliminary trials. The details of digestion together with a bleaching comparison of the soda process results, and the microscopic examination are as follows:--

| | Bombax malabaricum. | Salix tetrasperma. | Trewia nudiflora. |
|---|---|---|---|
| (a) Quantity of liquor per kilo of wood | 3,000 cc. ... | 2,500 cc. ... | 2,500 cc. ... |
| (b) Duration, temperature and pressure above atmosphere. | 4 hrs. 120lbs. 176° c. | 3 hrs. 140lbs. 183° c. followed by 4 hrs. 100 lbs. 170° c. | 2 hrs. 140 lbs 183° c. followed by 5 hrs. 80 lbs. 162° c. |
| (c) Yield of unbleached air-dry pulp ... | 37·4 % | 40·1 % | 41·3 % |
| (d) Quantity of bleaching powder of 35 % strength—percentage on weight of the unbleached pulp. | 14 % | 18 % | 13 % |
| (e) Colour obtained ... ... | Good white .. | Cream white | Good white. |
| (f) Quantity of bleaching powder required to produce a similar colour after soda treatment. | 24 % ... | Unbleachable. | 22 % |
| (g) Microscopic examination. Average length of ultimate fibre. | 2 m/m. ... | 1·6 m/m. | 1·8 m/m. |
| Average diam. of ultimate fibre. | ·03 m/m. ... | ·025 m/m. | ·03 m/m. |
| (h) Average weight of wood per cubic foot. | 23 lbs. .. | 31 lbs. | 28 lbs. |
| (i) Quantity required for 1 ton of pulp in cubic feet. | 260 | 180 | 194 |

In each case the resolution of the wood was complete and the pulp entirely free from chips or undigested particles. It was evident in the case of *Trewia* that the treatment was somewhat in excess of that necessary and probably as good results would be obtained by digestion at lower temperature. In the case of *Bombax* it was considerably in excess, with some loss of yield, in spite of both duration and temperature being less than in the other case. We may therefore expect that further experiment will show it can be reduced with weaker liquor with an improvement in the yield.

The remarks as to bleached colour have the following significance :—

Good white = Suitable for fine printing paper and common writings.

Cream white = Suitable for common printing and newspaper. In regard to strength and quality generally, I would place these pulps as follows: taking spruce pulp as the type of European and American first class pulps, and poplar pulp as the type of those of the second class, then *Bombax* comes out slightly superior to poplar and the other two equal to it. The average length of the ultimate fibre in all cases exceeds that usually found in deciduous trees and in the case of *Bombax* approaches that of the *Coniferæ.* The claim of the sulphate method to produce a stronger and tougher as well as a better bleaching pulp, is fully borne out by a comparison with the results obtained by soda treatment, and the most interesting feature of these tests is the evidence they afford of success of the combined hydrate and sulphide treatment in dealing with the colour difficulty.

This enquiry has not as yet proceeded far enough to enable anything like close estimates of the cost of such pulps to be framed. In particular, information as to transport of raw material from forest to factory and cost of fuel at factory is lacking and cannot be supplied until suitable manufacturing sites are suggested, and their advantages in respect of water or rail transport, for both raw materials and product, examined : so that it would seem preferable at the present stage to estimate the margin available for the unknown expenditures rather than attempt close estimates of the total nett cost.

The value of such pulps at the points of consumption—the paper mills—may be taken at Rs. 120 per ton. If we reserve Rs. 10 of this for profit—which, on a output of 150 tons per week and a capital of Rs. 6,00,000, would be equivalent to 12½ per cent. per annum. There remains Rs. 110 to cover all manufacturing charges, and transport of raw material and product.

Taking the Government royalty on standing timber at one anna per cubic foot of square timber measurement, which is about 78 per cent. of the whole tree ; the cost to the pulp maker, who uses the whole and does not waste the slabs, amounts to 9·36 pies per cubic foot. On *Salix tetrasperma* therefore, this item would cost Rs. 8-12-0 per ton of pulp. Assuming that the cost of coal does not exceed Rs. 10 per ton and that the manufacture is carried out on the sulphate system with the aid of a recovery plant, the manufacturing costs and charges, including repairs and depreciation of plant, wages and superintendence, and the royalty on wood, should not exceed Rs. 75 per ton of product. We thus obtain a margin of Rs. 35 per ton of pulp to cover transport of 1 ton of pulp to market and the extraction of 2½ tons of raw material from forest to factory. If we assume that Rs. 15 of this will be absorbed by freight of pulp to market, there remains Rs. 20 for charges on 2½ tons of wood. It does not appear to be a very liberal allowance but the aggregate per annum, Rs. 1,50,000, is large enough to warrant the consideration of light forest tramways in situations where water transport is not available. In the absence of full data the figures are not put forward as being anything more than approximate, and they are estimated on the most costly, as to chemical treatment, of the three species dealt with. It is probable that the margins in the cases of the other two will be larger. For the present, the margin arrived at may serve as a guide to the selection of manufacturing sites.

The pulps made from the Himalayan *Coniferæ* proved to be in all cases equal in quality and yield to those now so largely manufactured from their European and American congeners, and, in two cases at least, were distinctly superior in strength and bleaching qualities. Such pulps would be worth to the paper-mills

Rs. 7-8 or Rs. 10 more per ton than those dealt with above, and the margins available for transport would be correspondingly larger. The spruce, on account of its good natural colour and great length of fibre, is admirably adapted to the manufacture of the non-chemical form of pulp known as "ground" or "mechanical" wood-pulp, an indigenous source of which is badly wanted to enable our paper-mills to compete with the cheaper classes of imported papers. Where water power is available, in conjunction with spruce areas, this branch of the industry is well worth extended and close enquiry.

In the next and concluding article, grasses and grass-pulps will be dealt with, and the tabulated results of the whole enquiry given.

## A NOTE ON PYINKADO TIMBER.

Mr. R. S. Pearson, Imperial Forest Economist, sent me two specimens of pyinkado timber grown in Burma and Bombay, respectively, and suggested that a microscopical examination of the two might elucidate some of the causes of the general superiority of the Burmese timber. The results of my examination, which are recorded below, have justified Mr. Pearson's suggestion.

### GENERAL HISTOLOGY OF THE WOOD.

Thick-walled, non-septate, *wood-fibres* form a large constituent of the wood, and are responsible for its great weight and its strength.

The wood-vessels *(tracheæ)* are not numerous, and are arranged in more or less isolated radial groups (of two or more in a group). They are pitted and possess simple perforations. The older vessels are plugged with a substance which I have not examined micro-chemically, but which is certainly not resin.

The *wood-parenchyma* ("loose tissue") is particularly developed round the vessels, especially on the flanks of the groups of vessels. The cells have relatively thick walls.

The *medullary rays* are numerous, very narrow and shallow.

### HISTOLOGICAL DIFFERENCES BETWEEN THE TWO SPECIMENS.

(*a*) In the *Burmese specimen* the wood-parenchyma is smaller in amount, and not only are the wood-fibres more numerous, but

their walls are much thicker—in fact, so thick, that the lumen of the fibre is often almost obliterated, especially towards the ends of the fibre.

This greater abundance and greater wall-thickness of the fibres in the Burmese wood is doubtless responsible for the increased weight and strength of the Burmese timber that is indicated by the statistics given in Gamble's Manual. The Burmese wood has larger masses (or strands) of wood-fibres uninterrupted by weak parenchyma.

(*b*) In the *specimen from Bombay* the parenchyma is larger in quantity, and in places forms short tangential connexions between the adjacent groups of vessels. There are more numerous fibres with relatively thin walls and wider cavities (some having blunt ends).

It is well known that both tropical and temperate timbers belonging to one and the same species of tree may display very considerable distinctions in properties and structure. Nevertheless I thought it worth while suggesting to Lieut.-Colonel Prain that a re-examination of the herbarium material at Kew might show a specific difference between the Burmese and other Indian material included under the heading of *Xylia dolabriformis*. Such re-examination, by Messrs. Craib and Hutchinson, has now shown that some of the Burmese material is not *Xylia dolabriformis*, but is identical with a Siamese species *X. Kerrii* (Craib and Hutchinson). Several questions arise from these discoveries. Is all or any of the Burmese pyinkado timber obtained from *Xylia Kerrii ?* If any of the Burmese pyinkado timber be that of *Xylia dolabriformis*, is it different in structure and qualities from the same kind of timber grown in the Western Peninsula ? Is all the pyinkado timber of the Western Peninsula that of *Xylia dolabriformis ?* Possibly forest officers may be sufficiently interested in the matter to collect herbarium material and samples of timber.

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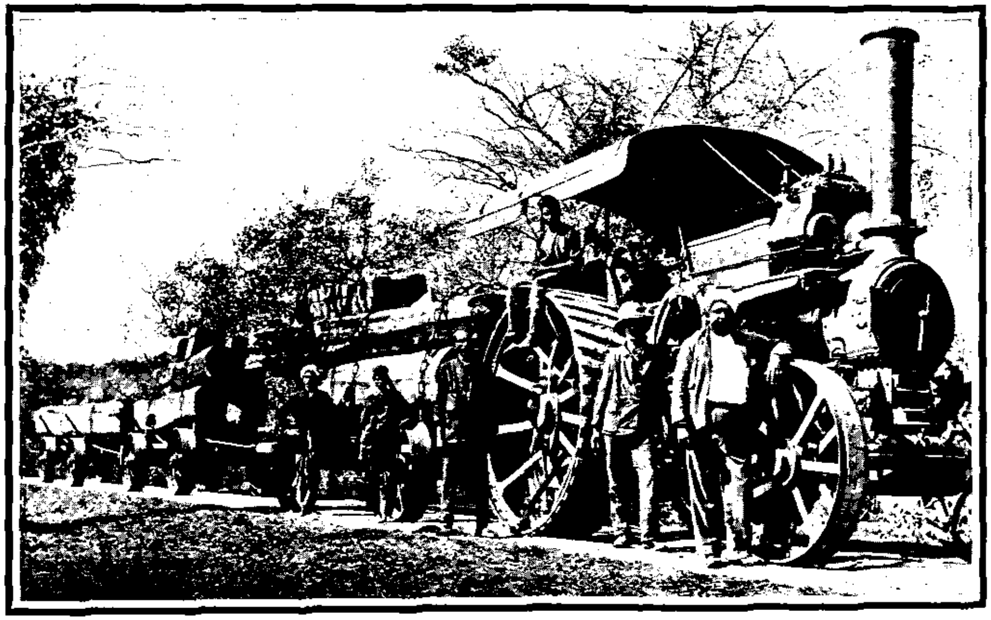
## MECHANICAL ROAD TRANSPORT OF TIMBER.

Particulars which may interest our readers have been received with regard to the road transport of timber by mechanical means. Until recently no attempt has been made to supersede the bullock cart for the road transport of timber, if we except such items as aerial ropeways and forest tramways, and even in these instances a certain amount of road haulage is generally inevitable. Bullock cart transport is not only excessively costly in many districts, but much of the larger, heavier and more valuable timber cannot be extracted by this means. The plant we describe is intended to overcome these objections and as will be seen from the figures we give, should, if properly handled, materially reduce the cost of road transport, even in districts where bullock carts are obtainable at cheap rates.

The plant consists of a road locomotive or tractor varying in size according to the load which it is desired to carry: the engine is so constructed as to be capable of burning wood fuel, which means very often that the cost of fuel under forest conditions is limited to the cost of the collection of the firewood. Behind the road locomotive are drawn from one to three specially constructed timber waggons, according to the size of the engine employed, and these waggons can be of 5, 6, or 10 tons capacity. The largest complete train which can be utilised for such work, therefore, would carry 30 tons nett load of timber and the smallest would carry 5 tons only. A decision as to what size and power of engine to adopt and what number and type of waggons, can only be arrived at after taking into consideration all the conditions, such as the state of the road, the distance to be travelled, the loads available, etc. To get the best results from such machinery it is essential that it should be kept as fully and constantly employed as possible, and with this end in view, it is sometimes desirable, for the purpose of avoiding delays in loading and off-loading, to provide three sets of waggons for one locomotive, in which case the locomotive itself would be kept constantly running, while one set of waggons would be loading, the second off-loading and the third on the road. To further obviate delays, it is also found



The Fowler Road Transport Train hauling timber,
from a forest near Shimoga, Mysore.

advisable in certain cases to employ portable-hand cranes or the loading and off-loading operations.

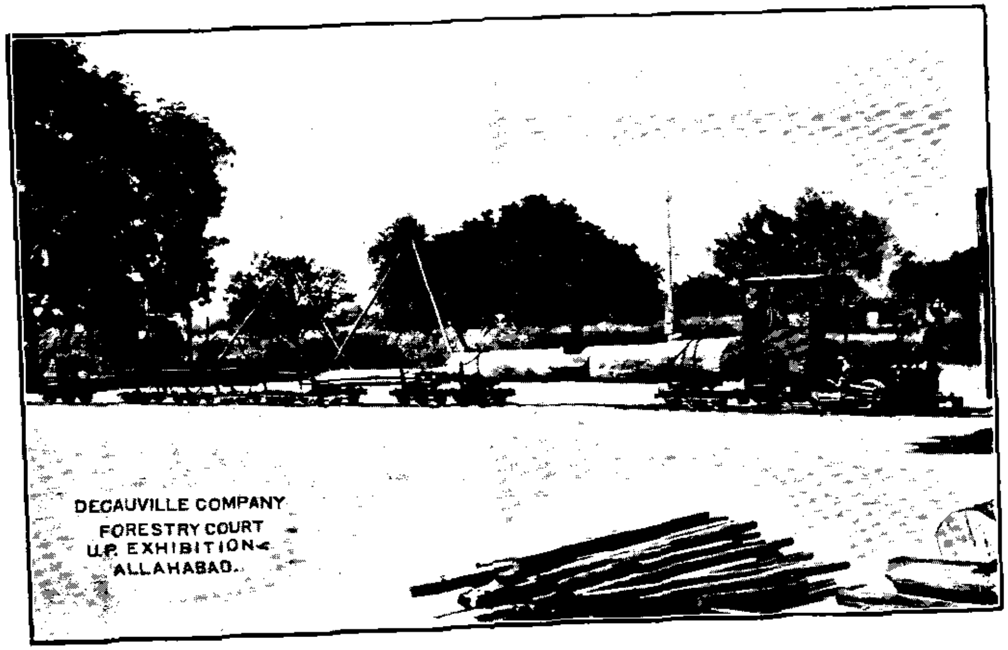
With regard to the working expenses of such a plant, this varies to a certain extent with the size of the road locomotive employed, the larger the engine which can be utilised the smaller being the cost per unit of work done, owing principally to the fact that the wages paid in connection with the running of a large plant are much the same as those for a smaller one, whereas the load carried in the former case is of course greater. On the supposition that it is possible to utilise the largest size of road transport train built for this purpose and that a double set of waggons is employed, that is, providing a set to stand for loading but not for off-loading as suggested above, the capital expenditure would be approximately Rs. 32,000. It is not always necessary to provide a spare set of waggons to stand while off-loading, as this operation can generally be performed very rapidly. In the above estimate of capital expenditure, provision has been made to cover delivery of such a plant to any reasonably accessible part of India and for all essential expenses in connection with the inauguration of the running, such as the wages and expenses of an expert European driver to erect and start the plant and teach local men. No allowance has been made for hand cranes for loading as this is not properly part of the transport problem, but rather an item to be considered whatever kind of transport is used. On the above basis the yearly working expenses would be as follows :—

| | Rs. |
|---|---|
| Allowance for repayment of capital or depreciation at 10% ... | 3,200 |
| Allowance for repairs at 5% on capital expenditure ... ... | 1,600 |
| Wages of driver at, say, Rs. 60 per month ... ... ... | 720 |
| Wages of steersman, at, say, Rs. 12 per month ... ... | 144 |
| Wages of coolie at, say, Rs. 10 per month ... ... ... | 120 |
| Wood fuel, say, ¾ ton per working day for 260 working days per annum at cost of collection, say, Rs. 2 per ton ... ... ... | 390 |
| Oil, waste, etc., at Re. 1 per working day ... ... ... | 260 |
| Total ... | 6,434 |

The amount of work accomplished for the above expenditure, if the plant is properly handled, should be the taking of 30 tons a distance of 25 miles daily, which is equal to 750 ton miles. As the

engine, however would have to return empty on alternate days this would only be on 130 days per year, if an allowance of 105 days per annum, as shown in the above table, is made for Sundays, holidays, repairs, etc., the total yearly ton mileage should therefore be 750 multiplied by 130 equals 97,500, and if we divide this into the yearly working cost, we get a cost of rather less than one anna one pie per ton mile, which figure is very considerably below the usual cost of bullock transport.

In addition to the question of cost, moreover, the weight of logs which can be handled by this method is only limited by the weight carrying capacity of the trucks. The advantages of having a substantial metalled road for such a transport service to run over are obvious, but this is by no means necessary, as these trains can be run over forest tracks, excepting in very wet weather when the road becomes too soft to support the weight: in their dry condition unmetalled tracks, unless of a very sandy nature, generally improve with the running of the train, the ground being compacted by the rolling action of the broad wheels. The method of transport described has several advantages over the forest tramway or aerial ropeway. With either of the latter systems a very large amount of capital is required, necessitating a large quantity of available timber within a moderately restricted area, to justify the initial outlay, moreover the cost involved in moving such plants to other districts is very excessive and the capital sunk in permanent-way and foundations becomes a dead loss. If the necessity for removal arises with the road transport train, the removal of the plant itself can be done practically without expenditure, and if any money has been spent on the improvement of roads or tracks, such improvements are much more likely to be of subsequent service than abandoned tramway tracks or aerial ropeway foundations. Further, the road train can often be taken to the very site on which the timber is felled, which would not be a paying proposition in the case of the light railway or aerial ropeway, for comparatively small quantities of timber. The ability of the train moreover to deliver the load at any desired spot tends to largely reduce terminal charges and double-handling in the depôt.




The Decauville Light Railway exhibited in the Forestry Court,
U. P. Exhibition, 1910.

All the road locomotives employed for this work are fitted with three speeds, nominally of 2, 4 and 6 miles per hour, though these can be exceeded when desired where the tracks are particularly smooth. When taking into consideration stops for water and fuel an average speed on the road of from 3 to 4 miles per hour is usual. Gradients up to 1 in 10 or even 1 in 8 can be negotiated in the low gear with a full load, given a fairly firm road surface. A winding drum is fitted to the hind axle carrying 75 yards of steel wire rope, and should any difficulties be experienced on the road owing to exceptional gradients or boggy ground, the engine can be run forward alone and the waggons hauled up to it subsequently by means of this rope. The winding drum and rope are also frequently used for hauling heavy logs out of difficult places in the forest; the power of the engine so applied is very great, its haulage capacity under these conditions being limited only by the breaking strain of the steel wire rope.

So far as we are aware the Conservator of Forests in Mysore was the first to adopt this style of transport for forest work in India, a plant (Plate 14) being supplied to him (by the manufacturers, Messrs. John Fowler and Co. of Bombay) some two years ago, since when he has been supplied with a second plant of a similar description. We understand that the Conservator of Forests in Travancore has also recently been supplied with one of these trains and one of the largest sizes is about to be delivered to the Central Provinces Forest Department for work in the Chanda District: in both of the latter instances portable hand cranes are to be utilised for loading purposes. We are informed also that the Forest Officers in several other districts are seriously considering the question of the adoption of this method of transport.

## THE DECAUVILLE LIGHT RAILWAY.

The Decauville Company of Calcutta (Head Office—Paris) has supplied as an Exhibit a Light Railway installation for the Forestry Court of the U. P. Exhibition. A description of this installation is, we presume, of interest to Forest Officers for several reasons.

The total length of the track is approximately $\frac{1}{2}$ mile and is composed of steel rails weighing 14 lbs. per laid yard on steel sleepers. Although wooden sleepers may particularly for forest tramways be cheaper than steel sleepers, the latter are undoubtedly better adopted for a line which may have to be shifted from time to time. The actual work of laying the track is exceedingly simple and inexpensive. The sleepers are supplied ready punched for the required gauge, and after the rails are placed in position there remain only the clips to be attached and the bolt-nuts to be tightened and the track is ready for use. With steel sleepers practically no earthwork or ballasting is required and the track can be laid on soft soil or rocky ground with the same ease. It will cost about Rs. 100 per mile to lay a track on steel sleepers, and it has been reported by the Conservator of Forests of an Assam division shat he laid his track (about 10 miles) at a cost of Rs. 80 per mile.

The installation has several sidings and a number of very sharp curves, one of which has a radius barely 30 feet.

The Decauville Company has supplied a 20 H.-P. Light Locomotive and a variety of rolling stock of which the timber trucks are the most interesting and at the same time most useful trucks for forest tramways. As the illustration (Plate 15) shows logs of every size can be carried on these trucks, which fitted with roller-bearings, run very easily and can easily be handled. The feature of these timber trucks is the turning bolster, which allows of the trucks negotiating very sharp curves, immaterial how long the logs are. Two trucks are loaded with a log about 30 ft. long and 4 tons in weight and it offers no difficulties in pushing these loaded trucks round curves of about 30 ft. radius. There are also a number of tipping wagons on the line, a most useful type of wagon for the transport of earth, stone, coal, etc. These wagons have been used for carrying building material.

Of interest to Forest Officers is further a hand trolley constructed after an American design. Instead of the old type trolley pushed by coolies this hand trolley is propelled by a lever connected with gear wheels fastened to the axle. The coolies stand on the platform and a speed of 15 miles can be obtained on a level.

The hand cranes, a part of Decauville's Exhibit, are constructed for 5 tons capacity. The beams consist of weldless tubes which, while being light, are exceedingly strong. The cranes are supplied complete with blocks and chains and they will be found exceedingly useful, as owing to their light weight, they can with perfect ease be carried from one place to another.

There can be no doubt that this installation has proved again that the cost of transportation can be very considerably reduced by a light railway installation and the simplicity of the Decauville railway line and the construction of the various trucks can only be the result of extensive experiments.

# REVIEWS AND TRANSLATIONS.

## INDIAN INSECT-LIFE.*

When the Agricultural Research Institute at Pusa was inaugurated, it marked a definite epoch in the history of applied science in India. Although the work of this Institution is mainly agricultural and directed to utilitarian ends, it is carried out on an essentially scientific basis. At present nowhere else in India is this all-important principle more fully recognised, or more extensively carried out in practice. The great importance of entomology in relation to agriculture, and consequently its intimate association with the lives of the vast proportion of Indian peoples, has thus begun to be recognised. The primary necessity is to build up reference collections and to classify and study the whole insect fauna of the agricultural districts of India. This is in itself a work of great magnitude, nevertheless it is necessary, before the blights and pests that confront the agriculturalist can be contended with. One section of the Pusa Institute has been given over entirely to this line of work, and is under the direction of the Imperial Entomologist, together with two additional European entomologists and a staff of trained Indian assistants.

The bulky volume before us is the outcome of the labours of Mr. Lefroy and his department during the past six years. Written in a clear and readable style, free from all unnecessary technicalities and eminently scientific in its treatment, the book should appeal to a wide circle of readers, and all who desire to contribute to advancing our knowledge of insect-life in India. Being essentially a text-book of the Insects of the "Plains," or "tropical India," the even more luxuriant insect fauna of the lower hill slopes of the Himalayas is of necessity omitted from its scope. In 1895, Dr. Sharp estimated that about 250,000 different species of insects

* A Manual of the Insects of the Plains, by Lefroy, H. M., and Howlett, F. M.—Pp. XII—786, 84 pls. and 536 text figs. Calcutta: Thacker, Spink & Co., 1909. Price Rs. 20.

had already been described, and exist in the various museums of the world, and that these probably comprise only about one-tenth of those that actually exist. Mr. Lefroy calculates that approximately 29,700 species are at present known from the Indian Empire. Of these about 10,000 are Lepidoptera, some 6,000 Coleoptera, and 3,600 Hymenoptera.

The book opens with an excellent introduction of some 40 pages in which are discussed the zoological position of insects, instinct and habitat, classification, entomology in India, zoo-geographical divisions, food and habitat, and the relationship of insects to man. The rest of the book consists of useful descriptions, life-histories, and much economic information illustrated by a great wealth of figures. Interspersed in the body of work is a series of remarkably interesting sections on Where Insects Live, Cosmopolitan Insects, Aquatic Insects, Relative duration of Life, Myrmecophilous Insects, Blood-sucking Insects, Song in Insects, etc.

There are a number of points in Mr. Lefroy's book with which we disagree, *e.g.*, the paucity of references to literature, the division of India into relatively small zoo-geographical territories of doubtful value, etc. It would, however, be captious to dwell on these when we have only the warmest praise for the bulk of this truly pioneer volume.

In spite of this large volume it cannot be asserted that we possess an adequate knowledge of any group of Indian insects with the sole exception of butterflies, and even among these much work still remains to be done, especially in the plains. Diptera have scarcely as yet been studied at all, vast groups of Coleoptera have hardly been collected as yet, while the Trichoptera, Perlidæ, and Chalcididæ are each in themselves a veritable *terra incognita*. It may be said that very little more than a description of the outsides of known Indian insects exist at present. Their life-histories are not known in two per cent of the cases, and nothing has been recorded concerning their internal structure or embryology. The author has done a great service in emphasising at frequent intervals the extent of the gaps and the enormous scope for future work.

A special feature of the book are the numerous well executed coloured plates, the work of Indian artists trained in the first instance in the art schools of the country. The Calcutta Phototype Company have carried out the work entrusted to them of reproducing the artist figures, in a praiseworthy manner. Mr. Lefroy is responsible for the bulk of the text, but the account of the Diptera and several minor groups is the work of Mr. F. M. Howlett, who is also responsible for a number of the text figures. Mr. I. H. Burkhill has contributed the section in "Insects and Flowers."

A. D. I.

## THE TREES OF GREAT BRITAIN AND IRELAND.

BY HENRY JOHN ELWES, F.R.S., AND AUGUSTINE HENRY, M.A.

This work, which is to be completed in seven volumes, of which only one remains for completion and which is, it is understood, nearly ready for the press, is the only existing up-to-date one of its kind. It has been dedicated, by special permission, to His late Majesty King Edward VII. In the Preface, written by Sir W. T. Thiselton-Dyer, it is stated that the British Isles offer a hospitality to exotic vegetation which finds no parallel in the Northern Temperate region of the globe. This is due to the even temperature as compared with other similarly situated countries. Down to the time of King Henry the Eighth the native forests supplied the timber necessary for nearly all local wants, and it was due to the abandonment of wood as fuel for coal and the facilities for external supply by over-sea carriage, which attach to a maritime country, that a scientific system, as exists abroad, was never developed. For the introduction of exotic species from an æsthetic and scenic standpoint, for which the old homes of the British Isles are so justly famous, we have to thank the wealthy landowners from the 17th century onwards who transferred the contents of foreign gardens to their own. The pioneer of arboriculture in this form was Henry Compton, Bishop of London, who planted in the garden of Fulham Palace "a greater variety of curious exotic

plants and trees than had at that time been collected in any garden in England." Those who care to trace the history of arboriculture in the British Isles will find abundant information in Loudon's "Arboretum et Fruticetum Britannicum"; a work which, though published over half a century ago, must always remain indispensable to any student of the subject. It is pointed out that the work under review differs from Loudon's master-piece, inasmuch as that the latter amounted to little more than a descriptive catalogue of every woody plant the cultivation of which had been attempted in the British Isles, but that the former aims at ascertaining the practical results. What are the most favourable conditions for the growth of each species? What in turn are the most suited for different circumstances? And what, if any, profit can be derived from their cultivation on a large scale? In the Introduction, written by the joint authors, the object of the work is to give a complete account of all the trees which grow naturally or are cultivated in Great Britain, and which have attained, or seem likely to attain, a size which justifies their being looked upon as timber trees; but does not include those which are naturally of a shrubby or bushy habit. The work is especially useful to landowners, foresters and arboriculturalists as it will enable them to distinguish the species with certainty or guide them in selecting the species best suited for economic culture in different parts of England. Most available works are based on foreign experience and conditions which are often not suitable to the British Isles, but the work under review deals in a practical manner, acquired largely from personal examination and knowledge, with the difficulties which would occur, naturally, in a country where no scientific forestry on a large scale has been carried out. All the measurements and observations have been carried out by the authors and in a few isolated cases, in which it was not possible to do so, specially competent men were deputed to do such work. The result is justifiably claimed that the possibility of error has been eliminated as far as is humanly possible.

In the six volumes under review, of which one is given up to photographic illustrations and drawings, there are no less than 408

species described with 339 illustrations. The size is $12\frac{1}{2}'' \times 10''$ and the number of pages of printed matter in each volume is, roughly, 200. The paper and print is all that could be desired. The binding might have been stronger and more suitable for such a valuable work, but it is presumed that suitable binding would have added very largely to the cost. The lists of contents are so arranged that any reference may be speedily found. A simple though sufficient botanical description is given for each genus and species. The conditions of growth, etc., in the natural habitats is fully given, as are also the economic values. Very full notes are given on the best methods to be adopted for propagation and tending. These notes are of great interest and value. The results of well authenticated experiments have been quoted and a list of remarkable trees is given, which should be of the greatest possible interest to foresters when on leave in the British Isles. In this way not only are new and old friends met with arboriculturally but also humanly. The observations made by the authors in foreign countries are extremely interesting. The illustrations are beyond criticism. The world has been ransacked to provide suitable subjects and countries as distantly situated as:—Chile, China, Bosnia, Japan, Palestine, United States, Canada, Sikkim, Switzerland, California, Algeria, Vancouver Island, Syria, etc., have been specially visited to this end. To the Indian Forester the chief interest lies in the descriptions of the coniferous and broad-leaf species of the Himalayas, of which the most important are contained in the work, and there is much information which is not usually available in other works. This work should encourage and foster the introduction of suitable exotic species into the Himalayas, of which there would appear to be a large number described. The Freemasonry amongst foresters is proverbial, and those who wish to visit any places mentioned in the work under review, when on leave, will assuredly be given a warm welcome. There is no doubt that the British Isles contain a greater number of varieties of temperate species than any other country in the world. The present impetus which is being given to Forestry in the British Isles should have far-reaching effects. Not only can a large

proportion of the timber now imported be grown locally, but also the opportunities for giving healthy and profitable labour to small farmers and their tenants, which do not exist at the present time, will be abundant. That there is such an interest being taken in the future of Forestry in the British Isles was clearly shown to the writer of this review when in Ireland during 1909 as many villagers eagerly asked him as to what the possibilities were of starting works of planting, etc., which, with the present depreciation of arable land, appeared to offer a lucrative and suitable form of employment. The idea that the unemployed of cities could be generally placed on such work is erroneous. The work under review has been issued at a time when its full value will be appreciated and the authors are to be congratulated upon having produced such a masterpiece of the utmost integrity, usefulness and interest. It should, certainly, take a foremost pride of place in any forester's, landowner's or arboriculturalist's library. As the work has been printed privately, full particulars may be obtained from H. J. Elwes, Esq. F.R.S., Colesborne, near Cheltenham, Gloucestershire, England.

E. RADCLIFFE,
*Kashmir Forest Service.*

*24th February* 1911.

# SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

## LIFE IN THE WILD.

In spite of centuries of civilisation, there are some of us who throw back strongly to the ways of our prehistoric ancestors. Those whose lives are altogether spent in the highly cultured countries of Western Europe very likely never become aware of the microbes of savagery lying dormant in their blood. A fair proportion of Englishmen, however, are taken, either by their profession or a love of adventure, to one or other of the wild lands over which the Union Jack floats. There, if the hereditary germ carried down

through the countless generations lurks in the man's system, it will out. The wilderness cries to him with a voice the strength and persistence of which is ever increasing, till at last the love of unfettered nature becomes a passion, unquenchable by anything save death. To explain the charm of wild mountain, pathless forest, and unploughed plains to those whom the fever has never touched is quite impossible; it would be like talking of music to a deaf man. The untrammelled freedom of a country which has never been subjugate to man, but is still the abode of wild beasts, is what appeals the most to these savage instincts of ours. If domesticated animals are turned loose they soon revert to their original condition, and their descendants rapidly lose any colouring they may have acquired while in civilisation. So we see men who for a time have gone back to the jungle show a strong disposition to cast off the clothing of civilisation and return to the apparel of the savage.

Nothing can be more weird, more mysterious, than night in the forest. Well versed in hunting lore though he be, a man will hear sounds at night which he cannot identify. The hours of darkness are not hours of silence, for there are birds and beasts whose day begins only after sundown, who seek their food in the black night while the diurnal creatures are sleeping. One of the very commonest animals in the East, the porcupine, is so completely nocturnal in its habits that it is rarely seen. Perhaps as you ride by moonlight your pony shies at a whitish, rustling something which crosses the track just ahead of him, or your favourite terrier, after a marauding expedition, will return with a stout and cruel quill embedded in the muscles of his chest. The silent watch over a kill for a goat-stealing leopard is full of eeriness and mystery. Ears are intensely on the alert, so that no sound in the vicinity is missed. Then is made startingly manifest that strange double life of the jungle—the life of the night as opposed to the much more familiar life of the day. Everywhere around are strange movements and rustlings, while those creatures which move across such of the foreground as is illuminated by the uncertain rays of the moon seem to take on fantastic shapes, until, after many nights of

watching, it is almost easy to believe in pixies and goblins, or even the strange beings of native legend. In Kashmir, on a spur overlooking the Lolab valley, we had pitched our dining tent under a huge walnut tree. Every night strange rustlings and chatterings used to come from its ample foliage, and walnuts detached by busy teeth would tumble from the tree. We took our visitors to be flying squirrels, and made attempts to shoot one of them; but though we had a big log fire close to and illuminated the walnut tree with pine torches as well, we never actually saw one of the animals nor established their identity for certain.

In the plains of India and Ceylon the great fruit-eating bats are no doubt responsible for many of the night sounds heard among the tree tops. Then there are huge insects of many kinds, whose crawling among the dry leaves adds largely to the noises which come from the ground. Crocodiles become very active at night, and make considerable excursions from their watery haunts. I have known a crocodile to walk 200 yards from the edge of a lake in which it lived, in order to reach the carcase of a dead pig. On its return it dragged the pig with it to the lake; the broad trail told the whole story next morning as clearly as though we had witnessed the entire performance. Sambhur and sloth bears are also creatures of the night, the deer particularly so in Ceylon, probably bacause they are so incessantly harried by hunters. On the Neilgherries and in Wynaad I used to see sambhur come out to feed comparatively early in the evening, while they did not retreat to their midday haunts till some time after sunrise. Bears in Ceylon are so seldom seen by day that it is customary to sit over waterholes for them in the hot weather. There are plenty of them in the island, and they find cave dwellings such as they love among the numerous rocky hills, which are a feature of the Ceylon forests.

Though it is so hard to know who or what are the makers of the incessant movement which is going on all night in the woods, the actual voices of birds and animals are by no means equally difficult to identify. In the hills, even in a big station like Mussoorie, are constantly heard the loud calls of barking deer;

the little creature's resonant bark is almost indistinguishable from that of a dog. The muntjac is said to be particularly vociferous when there is a leopard about. I have, however, often heard these tiny deer barking in a most excited way when there could have been no leopards within many miles. A very familiar warning of the approach of night is the squawk of night herons as they sail overhead. In most Indian compounds is found a family of quaint little brown owls, who come out of the hollow tree where they spend the day as soon as dusk descends, and begin their voluble chatter. Natives are very superstitious about the big grey-white owls, and consider them to be harbingers of evil; but no bad odour attaches to the merry little brown fellow, who is everybody's friend.

Hindus have all sorts of beliefs regarding trees. If you want a man to tell the absolute truth you take him beneath a pipal. Under the shadow of the pipal every Hindu is supposed to become a George Washington. In the Madras hills the natives always regard large trees as the abodes of devils. Near a bungalow I lived in at Wellington (ten miles from Ootacamund) there was a large hollow tree. In the hollow pious hands had erected a miniature altar of bricks, and on this were usually to be seen one of those little classically shaped clay lamps to burn mustard oil, and a few tiny coins to propitiate the devil who lived in the tree. On the other hand there are aboriginal tribes in Wynaad who never leave the shelter of the pathless forest. I have stood on a hill and, looking over the vast jungles of Mysore, have seen thin smoke wreaths ascending far away from the centre of the forest, the fires of these jungle men cooking their evening meal. (*By Fleur-de-Lys, in the Field.*)

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## TIGER-HUNTING IN CHINA.

In China goats are left tied to the mouths of the caves that tigers frequent, and as each dawn appears heralded by the chirping of a thousand swallows and all the brilliant colours of a Chinese morning, one tramps up into the hills to inspect the bait. If they

are at their posts untouched, bleating hungrily for breakfast, another monotonous day of waiting ensues, and one begins to doubt whether the Chinese tiger exists. Certainly the tales one has heard of the country seem but a snare and a delusion, and as the days lengthen into weeks, it is a sore temptation to abandon the quest. Then suddenly comes the first intimation that the game has arrived. In the dead of the night there is a tremendous uproar in the village street; the natives are running wildly to and fro, the huntsmen are preparing their torches and spears in a manner which suggests a sally against some hostile tribe. A tiger has entered the fields. This is, indeed, welcome news, for if only he has killed a goat there will be something to work on. At daylight the hunters are in readiness; their torches, formed of long bamboo rods with oil rags tied around their tips, are prepared, the idol is duly propitiated, and off we start into the hills, expectancy and hopefulness at top notch. The hunters light their torches and enter the cave as carelessly as though it were a pig, not a tiger that they expected to find within.

Meanwhile the sportsman stands a few yards away from the entrance, ready at any second to fire, should the animal try to escape. The excitement is now intense. The men are feeling around inside the cave, lighting their way with the torches, and guarding themselves with their spears against an attack. Suddenly, a dull roar seems to come from the depths of the rock; the men shout a warning, there is a loud *aughrr* and the tiger springs from between the great boulders. He will not go out of his way to attack, nor will he hesitate an instant, but makes off in great bounds down the mountain side; in that moment the sportsmen must shoot, and shoot accurately; no second chance is given. More likely, however, on seeing the light of the torches, the animal will cower back in the innermost recesses of the cave whence it will be impossible to dislodge him. On ascertaining his position, the hunters block up all possible exits with bundles of stuff which are thrown down from above by the villagers, who never miss the fun of seeing a hunt, and invariably gather on the hillside at a respectable distance from the scene of action. This blocking in of the

game often takes several hours, which are hours of tense expectancy for the sportsman, who must be ready at any second for a change of tactics and a sudden charge on the part of the tiger.

Finally, it is announced that the animal is effectively blocked. The sportsman drops down between the boulders that forms the entrance to the cave and having accustomed his eyes to the torch-light, he follows the direction of the hunters for approaching the tiger's retreat. He will perhaps have to wriggle on his stomach through some narrow passages dragging his gun by the muzzle after him. He is practically in darkness and his ignorance as to the exact whereabouts of the tiger renders his task one of peculiar interest. As he draws near, a low half-suppressed roar reveals the animal's position. Probably the sportsmen can now see through the chinks in the rock the glowing eyes and the great striped side, yet he is in no danger, for the huntsmen have done their work well, and left but a small hole through which the shot is to be fired. It is a novel situation thus to be within a few feet of a live tiger in a dark cave, and to see the green eyes blinking sleepily in the glow from the torches which have been thrust through the chinks in the rock underneath, and to watch the mighty head and great swelling muscles of the magnificent brute as he lies panting with anger. In spite of one's feeling of security, one does not dare to delay too long. The Express is dropped painfully into position ; the tiger, as he sees the muzzle approaching, draws back snarling. Then the report of the rifle resounds through the cave, and the hunt is over The body is dragged with difficulty to the surface, and slung from a pole, is carried by the hunters back to the village, while the natives follow alongside joyfully shouting, dancing, and generally rejoicing at the death of so dreaded an enemy.—(*By Nikola in the Madras Mail.*)

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## THE CUNNING OF THE HUNTED.

"As a rule, if you want to know the way of the tide you stand on the bank and watch which way things floating in the water are going. Isn't that so?" This was the question of a man in the train to the company, and the answer seemed so obvious that no

one took the trouble to make it. It was taken as "Yes." "But," said he, "I remember once we were standing on an island in an estuary of a river in British Colombia. We believed, as a matter of fact, that we know pretty well which way the tide was going, and were only waiting for it to turn before we put off in the boat, when one of the fellows who was there said, 'By Jove, look at that!' and we looked where he pointed, and there was a great bunch of fern going up slowly and steadily right against the tide! You begin to lose your bearings a bit when things happen that are against the ordinary course of nature, and we were all feeling rather foolish when the same fellow, who was the keenest-sighted of us all, said, in a tone of great relief, 'I see what it is—it's a deer swimming, and he's got some fern about his horns.' That was the explanation, simple enough, and we were all glad to have it; but as soon as we had settled that bit of trouble another arose and we were all arguing among ourselves whether that deer had put those ferns around his horns on purpose, for the sake of concealment, or whether it was all just accident."

We can imagine the discussion quite easily; we must have heard something of the kind a hundred times. In those rivers this mode of concealment is not an unknown thing when it is an affair of approaching wild duck or any fowl on the water. The plan is to get a great bunch of some greenery on the boat's bows and to paddle down gently towards the fowl. They are accustomed to seeing masses of greenery come floating down, and take very little notice of them, so that you may often paddle within gunshot. But in these manœuvres we always showed sufficient respect to nature's laws and to the intelligence of the creatures we hoped to deceive, to go down stream towards them, not to go right in the face of these laws, and, as it were, float up against the current as this bunch of fern on the deer's horns would have been doing if it had been a mere piece of flotsam and not a bush propelled by the strong swimming limbs of the deer. The duck were simple-minded people, but the spectacle of a green bush floating up to them against the current would have been such an uncommon one that it would have excited their suspicion at once. The experiment

has been made, and has failed. Therefore, if the deer was really a cunning beast, and seeking to conceal itself as it swam from the bullet of a man who might be awaiting its coming to the shore, it was not quite cunning enough, for to anyone who knew the way the tide was moving, this spectacle of a floating bush going against it was certainly much more arresting and provocative of attention than the head of a swimming deer ever could have been. It was, besides, a much larger object. So it was sure that if the deer was really endeavouring to deceive it was not doing so very cleverly, but as a matter of fact it is tolerably certain that it had no such guileful intention at all but was perfectly innocent. It had been dashing its head about in the fern, probably to get rid of the flies which are bad enough in these parts to make anybody dash his head against anything, some of the fern had gathered round his horns, and had stayed there even as he swam across the estuary. That, in all likelihood, was the simple explanation. Once upon a time they were otter-hunting on the Teme. The pack is rather a celebrated one, and was well versed in all the various wiles of the otter. They had hunted him long, and had brought him into a pool where he had been seen long after the sentinels had been posted at its entrance and its exit. It was morally certain that he was there still, but the hounds could make nothing of him. It seemed that he had vanished into thin air, or scarcely less fluid water. Then it happened to old "Rufus" Meredith—he is a "character" who will not be forgotten by those who have fished or hunted in that part of the Teme, he had perhaps a better knowledge of how to tie a fly to suit the tastes of the trout or grayling of the Teme than any other man in the world—to be poking about with his pole and wondering, like all the rest, what had become of the quarry, when he noticed a wisp of hay lying very still on the surface in a backwater. It was a backwater, but there was a little current even there, and it seemed to Meredith, who was a man that little escaped, that this wisp lay with a kind of unnatural stillness. They were cutting grass higher up, so there was nothing unnatural in the wisp having drifted down there. Rather idly, certainly without expectations, he stretched out his pole to this

wisp and lifted it over, and there, so quickly and so quietly disappearing that a man of less keen sight and less accurate knowledge of just what is seen when an otter, discovered, draws down his nose below water and becomes invisible, he saw just this happen —the nose disappear. That was all; but it was enough—enough to make him call the master with confidence to bring on the pack, and no man thought of doubting Meredith's word where "otter" was in question. It was an unfortunate accident for that particular otter that Meredith's eyes, in an inquiring moment, should have rested on that particular wisp of hay, not quite natural in its motionlessness on the sluggish flood. Any other man, perhaps, in the field might have seen it without giving it that fatal lift over with his pole. That incident, again, was the occasion of a very keen discussion on the intelligence of animals in general and the intentions of this otter in particular. Meredith himself—but though a keen observer, he was, perhaps, no great psychologist—was quite convinced that the otter had thought out the whole affair, and understood that the scent of the grass, passing into the state of hay, would effectively disguise the scent of its breath from the hounds. This, no doubt, is what did happen; for they must have passed close by this wisp time and again, and never had a hint of the otter's presence carried to their noses; and fresh hay, though pleasant to us, had no attraction for them; but it is a long step from admitting that fact was so to acquiescing in the theory that it had all been worked out in the otter's mind. It appears quite likely that the otter, swimming below the surface and seeing this wisp floating above him, had said to himself that here was a good chance to poke his nose up and get some badly needed breath without anyone seeing him, but that he should have thought out the effect of the hay in disguising his proper scent is hardly to be credited.

It is sure that a deal of the trouble that we find in understanding the doings of animals and the motives which prompt them arises from the habit of which we have so much difficulty in divesting ourselves of regarding them as thinking humanly. Before we can begin to understand them we must try to consider that they

themselves are only at the beginning of any understanding at all. It has happened to me lately to hear of a man instructing his dog to search for golf balls by the encouragement given by the word "Find." For long while he had trouble, because, when he wanted to check the dog from the search, he used the word "Behind!" meaning to say that the dog was to go behind him. But the poor dog had not been taught human speech, though he did know something about the meaning he was to attach to certain sounds coming from man's mouth. The sound of "Find!" is very similar to that of "Behind!" as we can realise at once if we can dissociate from our minds the very different ideas which the words convey to the educated human—that is to say, English speaking—intelligence. To a foreigner, not knowing the language, they might readily suggest the same idea; and so it was in the case of this poor bewildered dog. Soon the truth dawned on the master, and he substituted another sound "Back!" (he was not a sportsman, or he would have said "To heel!") when the hunting was to cease, and the mistake was then quickly cleared up—a mistake arising solely from the master in the first instance failing to put himself in the dog's place and to consider the case from the canine point of view.—(*By Horace Hutchinson in the Westminster Gazette.*)

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## PIG-STICKING IN BENGAL.

Some years ago I was stationed in Bengal, not far from Dinapore. Behar in those days was one of the most pleasant spots in the world, where good sport and good sportsmen made life worth living. Not far from where I resided there was a big grass jungle some 2,000 acres in extent. In this the greater part of the grass was about knee high, interspersed with bare patches. About 200 acres, however, was heavy elephant grass, not all in one piece, but divided up in lots of from five to thirty acres. It was in these patches that wild boar were to be found. The riding was rough, but not very bad, except for the holes here and there. Earlier in the season I had arranged a day's pig-sticking, but only got one boar. This, I think, was due to the fact that the raha

(*Revalenta arabica*), a kind of pulse, was still uncut, thus affording cover, of which for some unknown reason they were extremely fond. Not satisfied with the poor results obtained, I determined a month ater to have another day. My friends, however, with that frankness born of old friendship, declined on the ground that prospects were so gloomy, judging by past experience, that they did not think it worth while to turn out. However, a neighbour asked if his young brother, who had just come out from England, might be allowed to go in his place to which I, of course, assented.

We made an early start next morning, and it did not take us long, with one change, to drive the fifteen miles that lay between us and the jungle. The morning gave promise of intense heat, the sun appearing above the horizon like a great yellow ball—a sure sign that the day was to be a real stinger. Arriving at the grass, we found the jemadar, or headman, awaiting us with a goodly band of coolies marshalled under their various headmen. Our horses, sent on the previous night, seemed to scent the coming fray With ears cocked and one foot pawing impatiently, they seemed to say, "Come along, let us to work ere it gets too hot." The jemadar, an important personage by reason of his having a pony to ride, tells us that the villagers report a "burra-barri soor" (a very big pig) has come in after his nocturnal wanderings; but natives often say that which they think will please. Mounting our nags, I on a trusty old waler, the youngster on a pony, we get the line into order and make a start, tom-toms (native drums) being vigorously beaten to the accompaniment of shouts from those unprovided with musical instruments.

The line had not advanced more than 200 yards, when a shout on the left of "Barri soor!" made our hearts beat a bit quicker than normal. Galloping up, we found the barri soor to be a sedate old sow. We, of course, left her alone, as it is as great a crime to stick a sow in Behar as it is to shoot a fox in England.

Back to the beaters, who had hardly started, when a rush in the same vicinity once more raised our hopes. This time there was no mistake, for a young boar of 28in.—a pig is measured from the withers in a perpendicular straight line to the back of the hoof—

sailed away in front of us. Settling down in our saddles, we galloped for about half a mile before getting up with the quarry. A rush, and I just prick the boar. That prick, however, is quite enough to put him in a fighting mood. "Woof, woof," he grunts, and makes for the youngster, who in his excitement misses him altogether. No harm is done, however, the pony getting cleverly out of the way. Having come into his line of vision, I am made the object of his attentions, and a grand charge follows. But eye and hand work together, with the result that a fierce rush is stopped and the boar, reeling under the impact, is up and at the youngster again. The latter by this time having recovered his coolness delivers a good spear which would have done credit to any old hand. Still full of fight, the boar makes charge after charge, finally falling dead without a groan—a gallant foe, and a gallant fight.

Riding quietly back to the line, we are met by the jemadar who in a state of wild excitement informs us that a heavy pig is watching the beaters from a bare patch of ground about 100 yards from the line. Quickening pace, we canter up to the line, and true enough, find the jemadar's statement to be correct. Telling the beaters to stay where they are, the youngster and I walk our horses towards the boar, which seldom shows fight till he has had a run and been touched with the spear. This boar, a fine fellow of about 31in., proved an exception, for when we were about fifty yards from him he came at me like lightning. Getting my horse into a hand gallop, I proceeded to meet him, when just as spear was about to meet flesh the pig thought better of it and jinked to one side. Turning quickly, we were after him. A good gallop followed, when just as I was getting on terms with him my horse put his foot in a hole and came down, letting the youngster up on his pony. Picking myself up and remounting, I was just in time to see the youngster stick the pig fairly and squarely, another good fight ending in a kill.

By this time it was getting very hot, so we cried a halt to allow of iced drinks and sandwiches. After a short adjournment we again started off, the youngster still on his pony, I on another

waler, a seasoned follower of pig, but always very excited at first, indulging in "pig jumps" just to show his appreciation of the sport. The line beat slowly along, as though loth to leave a blade of grass unsearched, care which was duly rewarded, for we had not gone more than a couple of hundred yards when another boar broke making off as fast as his short legs could carry him, and to those who have never seen a wild pig travel the pace would appear incredible, a good gallop ending in the killing of a 26in. pig. We had, however, by no means finished, for two more boars, one of 30in., were added to the number of the slain before horse and man cried enough.

Riding back to where my dog cart was awaiting us, I had got within a hundred yards of the edge of the grass when my horse stopped short. Looking to see what could have caused this extraordinary manœuvre, I spied a large tiger cat looking up at me about five yards away. Now, in Behar we use the short spear with a lump of lead on the butt. Such a spear is never thrown, for the simple reason that the weight brings the butt down, causing the point to stick up—a menace alike to horse and rider. I was in rather a dilemma, for I knew if I rode up to the cat she would bolt into the thick grass. On the other hand, if I threw and missed, the point would most certainly stick up. As however, no one was riding near me I chanced the throw, with the best of results, the spear transfixing the animal. Her skin was afterwards converted into a handsome rug.—(*By A. S. V. H. in the Field.*)

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## TIGER KILLED BY A BOBBERY PACK.

SIR,—The following account of the prowess of a bobbery pack at Kolliapur may be of interest. The pack in question consisted of ten couples of mongrels such as are to be found in India, ten couples of terriers, and seven couples of English and Persian greyhounds. These dogs have been trained to follow a bugle and to hunt in a pack, and have already been responsible for the death

of two panthers and three bears. When actually at work in the pursuit of such dangerous game they are divided into sections, which are used as the huntsman may think fit.

On the morning of February 8th last word was brought by a farmer to His Highness the Chhatrapati Maharaja of Kolliapur, who was encamped some three miles out of Kolliapur city, that a tiger had been seen on the slopes of the well-known Jotiba Hill, a short distance away. The report was at first received with some incredulity, it being a common habit of the people to call any wild animal "bagh" (tiger), and the place itself being of such a character that no one would expect a tiger to appear in it. The man's tale was, however, considered by the one shikari in attendance to be so circumstantial that His Highness eventually decided to hunt the valley in which the animal was said to have laid up. Thinking that the so-called tiger was a panther, a hyena, or a wolf, His Highness set out with a few servants and his pack of dogs, but took no weapons of any kind. The approach of the party alarmed the animal, which at once took shelter in a field of sugarcane near by, no one getting a view of it. Still under the impression that the game was of a kind for dogs to tackle, one section of the pack was sent into the cane, and the consequent disturbance showed that the game was found. As it was seen that they could not get it to move, two more sections were sent to the assistance of the first and some half an hour afterwards, when the noise made by the dogs showed that they were attaining some kind of success and when from this and other indications it was judged that the animal must be a panther, the rest of the dogs were loosed with a view to finishing off the contest. After further waiting the subdued growlings of the supposed panther and the more confident tone of the baying and yelping of the dogs indicating that it must be unable to do any serious damage, the Maharaja led the way into the sugarcane. To his great surprise, when the party had penetrated far enough to see what was going on, it was found that the dogs were holding at bay and vigorously attacking a full-grown tiger. Catching sight of his new enemies, he made an attempt to charge, but was so pinned down by the dogs that he could not

move. The Maharaja and his servants, when they had recovered from their astonishment and realised their position, withdrew, and sent off in haste to a neighbouring village for weapons wherewith to despatch the animal, and so to rescue the dogs from their dangerous situation. Some spears and axes and a muzzle-loading gun were procured, but while His Highness was loading the gun the dog boys went to the assistance of their beloved pack, and the tiger was so exhausted that one of them was able to put an end to the fight by thrusting a spear through the tiger's body. The dogs had practically won when assistance came to them. When casualties came to be reckoned it was found that four of the dogs were dead and six were wounded, and that their adversary measured 9ft. 10in. in length, nor was there anything to show that he had not been in full possession of his fighting powers when the affray began. A bobbery pack had, through a mistake, been asked to face the most dangerous of opponents, and had won the battle. A liberal distribution of baksheesh to those who had distinguished themselves completed the proceedings, and His Highness the Maharaja of Kolliapur now rejoices in the possession of a bobbery pack which has accomplished what no other has ever attempted.—*(By A. Darby in the Field.)*

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## THE SPIDER.

Aranea, a Linnæan genus, now divided not only into many genera, but into many families, and constituting a section (araneida) of the class Araponida and order Pulmonaria. The species are very numerous and are found in all parts of the world, but most abundantly in tropical climates, which also produce the largest species, some of them capable of making very small birds and not merely insects their prey. The cephalothorax, formed by the combination of the head and thorax into one piece, is covered with a sort of horny buckler, generally of an oval form; the abdomen is attached to it by a short stalk, and is generally soft and tumid. Each of the eight legs consists of seven joints, the last

armed with two hooks, which are commonly toothed like a comb. The frontal claws, commonly called mandibles—which do not, however, correspond to the mandibles of insects and move in an entirely different direction, up and down—are terminated by a sharp moveable hook, which has near its extremity a small slit for the emission of a venomous fluid secreted in the gland of the previous joint. All spiders kill the insects and other small creatures on which they prey by means of their venomous mandibles, and the bite of a house spider is quickly fatal to a housefly. The bite of the larger species is dreaded even by man, being very painful, and not only producing much inflammation and swelling, but often much fever. Death has been known to ensue. Spider's webs have long been in high repute for staunching wounds. Threads of this material are also employed for the crosswires of astronomical telescopes. Textile fabrics have been made of it, but only as articles of curiosity.

Prowling spiders, which have nests but prowl about in their neighbourhood or in that of the threads which they spread to catch prey, are very interesting creatures indeed, and here is my experience of a day's observation of one of these creatures.

On this particular June evening, the spider had been tempted to climb the brick wall, which was warm and pleasant to the touch in the sunshine by comparison with the damp ground. Finding the window of the drawing-room opened when she had ascended a few feet and discovering a most advantageous site for a snare for flies that might by going in and out between the sill and the lighted window-frame, she immediately set about the construction of a web, obviously not having yet breakfasted. Any mere human being who had to build a trap of the same size in its proportion to its own, and if as complicated a pattern would have required a force of workmen, and two or three days' time, as well as all kinds of mathematica and mechanical aids. But the spider, though she would probab y have been unable to name either the elements of reference by which the point of a c1rve is referred to a system of fixed rectilineal co-ordinate axes, or to explain the difference between an algebraic and elliptic function, had inherited from a long

line of web-making ancestors the ability to design and execute, often in less than an hour's time, and without artificial assistance, perfect geometrical figures constructed on the highest scientific principles, and was further provided with material in her own little body, whereby she could supply the thread to weave these patterns as well and utilise them to obtain her food-supply. We all know that the spider's web thread is drawn out from a glutinous secretion in the spinnerets that hardens as it is exposed to the air, but naturalists were a long time trying to decide whether the spider could project the thread to the spot where she might wish to fasten an end of the web, or whether the gossamer had to be carried or was moved by air-currents to the desired spot, and they are not entirely agreed upon the matter now. However, the divergence of their views did not bother this spider. She was provided with six spinnerets each one pierced with something like 100 holes, so that more than 600 separate strands went to make the one slender line she used in her business, four of the spinnerets giving out the long threads and the other two moving 200 shorter strands from side to side, weaving them all into one. Most scientists who lived a 100 years ago being gifted with the necessary patience, took the trouble to make measurements and computations whereby they reached the conclusion that it would take 4 million of the threads of a certain very small spider they were investigating to make one hair of their own beards. The spider who had never heard of these scientists began the construction of her net by sticking a bit of gum about 12 inches from the left end of the door pane which was about a foot wide and was raised above 4 feet from the sill: this she effected by touching the spot with one of her spinnerets. Then fastening the end of her thread to this gum and spinning out the line as she went—holding it off with one of her hind feet, which are fitted with tiny combs for the purposes, he proceeded to form within this open space a square, three corners of which were fastened respectively to the sash, frame and sill of the window, while the fourth was held in place by guy ropes attached above and below. The spider now ran back to her original starting place and dropped down on her

thread to the opposite corner of the square and attached the thread there. Ascending this same line without making any measurements she now fastened one end of the thread exactly halfway and carried it to the top, holding it off from the other line with the hindmost hind leg and carrying it out about an inch to the right, and fastening it to the line at the top, thus forming, with the line drawn clear across and intersected in the middle, a third spoke of what would eventually resemble a wheel within the square. With the utmost rapidity she ran down her last spoke and carried up another line as before, repeating this process again and again until she had gone clear around the square. The spider then ran to the centre of the web and began to spin a spiral line along the spokes of her wheel. The spiral having been carried to the outside of the web, she began then another and a closer web spun from thread of a different kind, the first having been smooth, while the latter was covered with a sticky liquid which collected on it in drops and caused it to adhere to anything that it touched. After circling round a couple of times this spiral would have crossed the one that was spun first which was merely a scaffolding to hold the structure, while the permanent lines were placed, except that as she came to the old spiral, she tore it away, leaving only little rags, almost imperceptible, attached to the spokes. After her web was complete she came down to the centre of the net, and in hanging head down waited for her breakfast. A yellow demon swooped down upon her, and it was only her wonderful quickness in making use of her own natural resources that saved her life. The monster which appeared to move from its tail, had first with one dash swept her and her web together to the floor with the obvious intention of crushing her under itself. The spider, however, almost with incredible swiftness had glued an end of its thread to one of the thick yellow hairs of her murderous enemy, and swung out behind it on this cable, which she lengthened so rapidly during the brief fraction of a second, she was flying through the air, that she dropped lightly to the floor, about 5 inches away from her would-be murderer, and fortunately for her, close to a big table directly before the window. She darted

under the piece of furniture like a bolt from the blue and worked herself into a ball not bigger than a pea. For several moments she was in dire peril, for it was a particularly vigorous maid who was handling the broom; the broom-wielder had the advantage in size and strength and she did not relinquish her sanguinary project concerning her hereditary foe until convinced that the spider was somewhere safe out of reach, temporarily at least. Sad experience had taught the spider that danger lurked in the vicinity, so she left the house and I saw no more of her.

A very interesting species, one of the most interesting possible inmates of an aquarium, is the common water spider (*Argyroneta aquatica*) of Britain, not unfrequently to be found in deep ditches and ponds in some parts of England. It is of a brownish colour, densely covered with hairs, which are of great importance in its economy, entangling air, which the animal carries down with it into the water, to supply its pulmonary sacs, for the water spiders all breathe by the same kind of organs as their terrestrial congeners. The eggs of the water spider are attached to the leaves of a plant under the surface of the water, and are protected by a dome-shaped web, so close in its structure as to retain the air which is brought into it, and in which the spider itself lives, bringing down air in its furred body till the dome is filled. The entrance is from below.—(*By Nikola in the Indian Field.*)

# EXTRACTS FROM OFFICIAL PAPERS.

## REPORT OF THE IMPERIAL FOREST RESEARCH INSTITUTE FOR 1909-10.

*Review of the Government of India.*

The most important event of the year, as affecting the Research Institute, was the meeting of the Board of Forestry in April last and the resolutions passed recommending the lines on which Research work should be carried out in future, and putting forward

proposals for the improvement of that work. The Government of India are pleased to observe that the meeting of the Board has already borne good fruit, and that the aims and objects of the Institution are now better understood, and that assistance has freely been rendered by Forest Officers in all provinces. The growing usefulness of the Research Institute as a Bureau of enquiry, both to the Forest Department and to the public, is observed with much satisfaction.

2. Good progress in the various investigations was made during the year. It is noticed that in some cases the economical investigations have led to the conclusion that certain woods are suitable for specific industries, *e.g.*, the wood of *Cupressus torulosa* among others for the manufacture of pencils. Such conclusions should be followed up and every effort made to give practical effect to them by the development of trade in the product concerned. The Government of India attach special importance to the development of the paper-pulp industry and look with interest to the result of the enquiries now being made.

## TIMBER SLEEPERS IN THE U. S. A.

The United States have reached a crisis in their railway economics with a suddenness in keeping with all movements in that country of surprises. Here is a country which 400 years ago was nearly all virgin forest, and containing timber which it was their boast until quite recently could be rivalled nowhere for size or plentifulness. We have noticed there has been some silence on this subject in the last few years, and have also noticed the States have with some haste and perturbation been trying to organise a forest service remotely resembling our own scientific establishments in India. And in so doing they have been somewhat heated and precipitate, insomuch that this purely domestic question has loomed large enough to fill the field of politics, and to threaten political disaster in certain State elections. The secret is now out. The huge forest fires which year after year have been permitted to sweep over the country in a way to astonish the world, but which the world has been deluded into connecting (*vide* the thrilling works of their own romancers) only with heroic rescues and sentimental situations—these forest fires, we say, have, as a matter of plain fact, wiped out one of the country's greatest assets. And, as if to assist this destroyer, timber cutting has been permitted to proceed recklessly and unchecked, without a State department to stay the hand of the tree-feller or to plant where he felled,—and behold the result ! "The first consignment of rail road ties from Australia to the United States is on its way to Rodondo, Cal., the ties being 62,000 in number, and cut from what is called iron bark wood." The United States is thus now beginning to bring the timber it requires over one-third of the surface of the globe and should stand as a warning to others who place a short-sighted value on their forests.—(*Indian Engineering.*)

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## TRANSPLANTING TREES.

### LIFE RESTORED BY WATER UNDER PRESSURE.

The growth of transplanted trees is often greatly retarded, if not entirely checked, by the drying which the trees experienced in

the course of their removal from the nursery to their final sites. For this reason the agricultural experiment station of Wisconsin has been trying the effect of restoring to the tree the water lost by evaporation, by applying water to the roots under slight pressure.

In order to carry out this plan it is necessary to have a certain quantity of water supported at the level of the top of the tree and placed in communication with a root by means of a tube, so that the pressure exerted by the column of water can be transmitted to the sap vessels. The apparatus used is very simple, consisting of a small vessel attached to a piece of gas pipe, which is closed at the bottom. The root is connected with the gas pipe by means of a rubber tube and a lateral tubulure (a tubular opening).

At the moment of application one of the large roots is laid bare, and the apparatus is set up at such a distance that the rubber tube can be easily connected with the root, where it is made fast by tying. The vessel is then filled with water, which is absorbed more or less rapidly, according to the condition of the tree. The effect of the operation is often perceptible within forty-eight hours.

### SOME EXPERIMENTS

A beech tree transplanted in April was subjected to the treatment some time in May, when it had given no indication of life. Six days afterwards the buds opened and the leaves appeared. Similar results were obtained with plum trees, but the most striking result was obtained with seedling apple trees. Twenty of these trees had been used during the winter by the students in practice in transplantation, and had consequently been exposed to many variations of temperature and moisture.

In the spring of last year all of these trees were planted in the same manner, and in the same soil, and half of them received the hydraulic treatment. A week after the treatment, the trees which had received it began to open their buds, and two weeks later they were in full leaf. During this time only one of the untreated trees had shown any indication of growth. It should be observed, however, that in autumn all of the trees, with the exception of two of the untreated trees which had died, had made substantially

equal growth. Hence the benefit produced by the water treatment appears to be confined to rousing dormant life and accelerating initial growth.

This treatment is indicated whenever young trees have been made unusually torpid by freezing or drying, and when it is desired to transplant trees without cutting them back.—(*Popular Science Siftings.*)

## AFFORESTATION OF MOUNTAIN LANDS.

[*Extract from a paper read by Mr. A. C. Forbes at the Annual Meeting of the Agricultural Education Association, held at Bristol in* 1909.]

It is generally admitted that the production of commercial timber must be confined to the area lying below 1,500 ft., for, apart from a few isolated examples, there is no evidence that timber of commercial value has ever been produced above that elevation. Many foresters, indeed, place the vertical limit of profitable tree-planting at 1,000 ft., but the absolute limit depends upon the configuration of the ground, aspect, soil and the absence or presence of adjoining shelter, and no hard-and-fast rule can be laid down on this point. One thing is certain, however, that the plantable area lies below the 1,500 ft. contour line, and the question then amounts to this: Can we assume that the whole of the waste land below that level is adapted for profitable afforestation? The Commission on Coast Erosion assumed that it was, but it was not clear from their report that evidence was obtained to confirm this assumption. If the evidence afforded by the scattered plantations growing in different parts of the country above the 1,000 ft. line is taken into account, it will invariably be found that the class of timber produced by these plantations is not of the first quality, being short boled, of small diameter, and seldom of sufficient value to do more than pay for its cultivation, leaving profit out of account altogether. These plantations, of course, have not always been produced under the most favourable conditions. Most of them are small and much exposed to wind. Many have been neglected from the start, and it is not uncommon to find the species selected

and methods of planting employed more or less unsuitable for the soil and situation. Under such circumstances, the results obtained cannot be regarded as conclusive or final in any way, but wherever any approach to profitable results is found, it will invariably be seen that the soil and situation are more favourable than the average. The generally poor development of timber trees in Great Britain at similar elevations to those at which profitable timber crops can be produced in Central Europe can easily be accounted for, when it is remembered that practically all land over 2,000 ft. and a very large proportion of that above 1,000 ft. lies on hill-tops, ridges, and narrow slopes which are exposed to winds from all points of the compass, while the soil itself is so thin and so often covered with wet, spongy peat, that both the climatic and soil conditions must be regarded as abnormal and more or less unfavourable. To compare such land, therefore, with that found at similar elevations in the higher mountain ranges of France, Germany, Austria, etc., is scarcely justifiable from a forestry point of view, apart altogether from the fact that the average climatic conditions of the British Isles are not so suitable for tree-growth at high elevations as is the case at lower latitudes, in which summer temperatures are much higher, giving as good or even better a climate at 3,000 or 4,000 ft. as may be found in the British Isles at 1,000 ft. This fact assumes greater importance in face of the Commission's recommendation that the large area of 9,000,000 acres should be planted to give a return of 3 per cent. on the money invested. In that area a certain proportion of poor agricultural land was included, it is true, but the bulk of it was assumed to be mountain land, which has always been regarded as unfit for cultivation on account of its sterility and elevation. Before any serious attempts are made to carry out these recommendations, therefore, it appears to me that experiments and observations are needed to show, not so much the results, as those can only follow the actual work, but the climatic conditions under which the work will have to be carried out, together with the behaviour of such hardy species when planted under proper conditions, as are calculated to furnish the necessary financial returns on land above the 1,000 ft. contour line.

At the present moment it may be said that we know next to nothing of the climate of our mountain ranges. With one or two exceptions, our meteorological observations are confined to low-lying stations, which give us, perhaps, some statistical idea of the weather in which our farm crops and animals live and develop, but leave us more or less ignorant of the weather on mountain slopes 500 to 1,000 ft. above the ordinary level of cultivation and human habitation. That the subject is one of some importance is proved by the fact that climate plays a very important part in bringing forest trees to maturity. Soil conditions may be improved by various means, but the general climate of a country situated as are the British Isles cannot be altered, and possibly not even influenced to an appreciable extent by human agency. If, therefore, climate is unsuitable for the proper development of trees on high-lying mountain land, a very large area of what has long been regarded as plantable land must be received with grave suspicion by the economic forester. How little has been done to answer this question one way or the other may be seen by the small number of high-lying meteorological stations in the British Isles. Of the stations reporting regularly to the Meteorological Office only one lies above the 1,000 ft. contour line, with such stations reporting to the Royal Meteorological Society and the Scottish Meteorological Society are but two, the former having one on Dartmoor, and the latter one at Lanarkshire. There are, no doubt, private stations in addition to these three, but they cannot be numerous, except those recording the rainfall only, of which some 280 or so are given in British rainfall.

How generally the climate of a high-lying station may vary from that belonging to a station at ordinary levels may be seen from the following examples: Nenthead, on the Pennine range in Cumberland, lies at an elevation of 1,400 ft., while Hexham, in the Tyne valley, and about 20 miles to the north-east of Nenthead, is but 220 ft. above sea-level. The average of five years' observation at each station is as follows:—

| | May. | | June. | | July. | | Aug. | |
|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| Nenthead ... | 50·9° | 35° | 57·8° | 51° | 61·4° | 44·8° | 58·1° | 43·2° F. |
| Hexham ... | 60·8 | 38·8 | 66·8 | 44·4 | 71·8 | 48·6 | 68·6 | 45·8 F. |

These figures are merely given to illustrate the difference a few hundred feet in elevation may make in the temperature of the summer months alone. When the heavier rainfall which is invariably experienced in mountain districts is considered, together with the colder and stronger character of the winds at all seasonsof the year, it is obvious that mountain climates must possess a much lower air temperature and a colder and more water-logged soil than are found in the valleys below. In 1907 the average amount of rain registered at 61 stations in England and Wales, all lying above 1,000 ft., was 53 inches, and the average number of rainy days 234. The averages of 71 stations taken independently of altitude were 36 inches, and 203 rainy days. It is evident that this heavier rainfall must be accompanied by an increase of cloud and diminution of temperature as compared with lower lying stations, both of which conditions are unfavourable in promoting vegetative activity. These features are probably responsible for the great development of peat on most of the mountain land above 1,000 ft. elevation, unless the surface happens to be of an exceptionally porous nature.

Such conditions of climate and soil cannot be otherwise than adverse to the development of most species of trees, and probably have much to do with the difficulties met with in getting the hardiest species to start freely away on mountain slopes.

The little evidence that exists as to the climatic conditions of mountain land, therefore, would tend to throw doubt on the reliability of the estimate made by the Coast Erosion Commission rather than to strengthen it. In the face of the scanty data available, however, no conclusive opinion can be formed one way or the other, and this would indicate, in my opinion, the great need for such experimental work as I have suggested in the title of this paper being undertaken without delay. Such work, however, requires funds and some system of co-operation between the various practical and scientific bodies interested in one phase or another of the object, specially those representing forestry, meteorology, and soil chemistry and physics.

As regards funds, we have the consoling confession made by Mr. Lloyd George, in introducing his last Budget, that Great Britain spends less than any other European country in research work, coupled with the announcement that £200,000 is to be devoted to the development of agriculture and forestry. As regards the latter, I do not know of any better way in which a portion of the funds could be spent than in the formation of these combined forestal and meteorological stations in the more doubtful portions of the vast area referred to in the Commission's report.

Concerning the co-operation of interested individuals and institutions, this association might be well employed in formulating a satisfactory scheme with the stated object in view, and I would only mention the meteorological societies of England and Scotland and the forestry societies of England, Scotland, and Ireland as bodies likely to assist them in the work.

Coming to the more practical aspect of the scheme, I should like to state as briefly as possible my ideas as to the distribution of such stations, their position, size, formation, and management. First, as to distribution, mountain land is chiefly situated in the North of England, Scotland, Wales, and Ireland; and in these portions of the United Kingdom stations should be distributed as follows, to begin with, *viz.*: two in the west and two in the east of Scotland, one as far north, and the other as far south as possible on each side of the country; one in the Lake District, one on the Pennine Chain, three in Wales, and three in Ireland, north, south, and west in each country respectively. The position of such stations should in all cases be on land lying between 1,000 and 1,500 ft. above sea-level. We already know that tree-growth on fairly good soil presents no great difficulties below 1,000 ft., but above that height we are very largely in the dark. At such elevations the best land and the most sheltered sites possible should be selected, for it is upon such soils and sites that the real work of afforestation must begin, if it begin at all. The summits of low hills, very rocky ground, or very exposed aspects should be avoided, and localities should be chosen which would allow a reasonable amount of

development and extension of area in the event of the first trials proving successful.

As to the final value of such stations to practical afforestation, time alone can show. But they can scarcely fail to add to our knowledge of mountain climates within a very few years, while the behaviour of various species under what may be termed exceptional conditions will be more clearly seen as time goes on. I do not suggest for one moment that it is necessary or desirable to defer the afforestation of mountain land until such experimental work has been carried out and the results made evident; but I maintain that the early stages of any large scheme of hill planting should be associated very intimately with work of the nature referred to, for upon the result of such experiments the future and ultimate development of forestry in the British Isles must depend, unless a haphazard and happy-go-lucky system, involving enormous capital expenditure and alternately fluctuating between wasteful extravagance and niggardly cheese-paring, is to be the order of the day for several generations to come. The great educational value of such work alone, and the opportunities it affords for solving several interesting problems in climatology, acclimatisation, and biology, have appeared to me a sufficient excuse for bringing the subject before this association in the hope that it may do something to further the scheme generally in whatever direction it may think fit.—(*Timber Trades Journal.*)

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## NOTES ON SOME F. M. S. TIMBERS.

*Carapa moluccana*, Nireh or Niris.—In a visit to Setul recently I found a Malay working at large-sized beams of a red hard wood and asked him what it was. He told me it was Niris (*Carapa moluccana*) and so it appeared to be. The tree, so common in our mangrove swamps and easily recognised by its cannonball-like fruits, is in the south of the Peninsula a short gnarled and bent tree out of which it is impossible to get a straight beam, and it is consequently little used except as firewood, or for short posts. It was formerly, at least, used for splitting granite at Pulau Ubin, by

burning it on the rock and throwing cold water on the heated stone. The trees along the tidal river at Setul, however, were of great size, tall and straight, and some, the Malay informed me, were over six feet in diameter and it was the best timber for beams that they had.

There is no doubt that a tree may vary in value as a timber tree very greatly in different locality, or, perhaps it should be said different climates, although it may be, as far as its species is concerned, identical in flower, fruit and leaf, and a tree that is a valuable timber in one country may be of little or no use in others.

*Carallia integerrima.*—Mr. R. S. Troup, in pamphlet 11 of the Forest Economy Series of India, gives an account of the timber of *Carallia integerrima*, called "Merpoin" and "Kusinga" here, a not very uncommon tree in the Malay Peninsula. He gives the dimensions as follows:—"The tree ordinarily grows to a height of 50 or 80 feet with a girth of 6 or 7 feet and a clear bole of 40 to 50 feet. Logs of 50 to 60 cubic feet in Burma. In Bombay and Madras it reaches a height of only about 40 feet with a girth of 4 or exceptionally 6 feet and a clear bole of 20 feet." Now this tree never seems rarely to attain anything like this size in our forests. It is usually about 30 feet tall and has a comparatively short clear bole. A note on a specimen collected by Mr. Cantley's plant-collector, however, in Malacca, gives a height of 80 feet and says it will produce beams. *Carallia integerrima* is however a very variable tree in foliage and perhaps some forms are bigger than others.

*Sindora Wallichi*, var. *Siamensis.* Saputi.—A fine tree of this species, long a conspicuous object on the lawn of the Botanic Gardens, was found last year to have somewhat suddenly died, it is supposed, from lightning. The tree was about 90 feet tall and branched very low, the butt was four feet through. When cleared away it was found that the wood was extremely hard, difficult to cut and split, the bark corky brown an inch thick. The sapwood is at first cutting white but soon darkens in colour, and a black resin exudes in rings. The heartwood at first is dark red reminding with its black resin of Rengas (*Melannorhœa*) but eventually is dark and light brown. The rings are well marked

but very irregular in width; in one part of the trunk I counted ten to the inch. The rays are very fine and close, the pores not very abundant, but moderately large like those of Merabau (*Afzelia*) to which this tree is closely allied. The wood indeed much resembles Merabau except in colour being brown instead of red. It has a good figure, and is harder than Merabau.

The Saputi, though seldom as thick as Merabau and not so heavily buttressed, attains a height of about a hundred feet or more, with a straight cylindric stem when grown in high forest and a large round crown. The flowers are produced in great abundance and fertilised by flies, the roar of whose wings can often be heard from the base of the tree when in flower. The flowers are green, and produce a circular flat pod covered with thorns, and containing one flat round dark brown seed, with a waxy reddish yellow aril half as large and oblong at the base. This aril is eaten by rats who carry about the seeds thus. The tree fruits heavily and seed is readily procurable and germinates well, like all good timbers. Saputi is a slow though steady grower. The wood though it does not appear to be very well known to timber dealers should be as good at least as Merabau and it seems actually harder. It seems well worthy the attention of foresters. The tree occurs all over the Peninsula from Singapore as far north as Bangtaphan in Siam at least.

*Balau.*—This timber was formerly reckoned one of the most valuable and durable in the Peninsula, but of late it has been noticed that the timber sold under that name is by no means as valuable not lasting for more than half as long as the old Balau of the trade.

The original Balau was a tree belonging to the order *Rosaceæ* and known as *Pygeum oblongifolium* Hook-fil. An account of this timber and the tree was published in the first volume of the Bulletin, new series, p. 144, where the difference between the two timbers known by the name Balau is pointed out.

As there noted the Balau of the present day which still comes from the East Coast of Pahang, whence to a large extent the original timber came, is not a *Parinarium* nor does the plant in

the least resemble one, but is a species of *Shorea (Dipterocarpaceæ.)* On several occasions leaves of the modern Balau have been sent by forest officers, but leaves alone are useless generally in identifying specimens. Recently, however, Mr. Sanger Davies has been able to procure specimens of the flowers of one species called Balau Bukit and unripe fruits of Balau Betul.

More complete specimens are required of the ripe fruit of both and flowers of the latter species, but the materials are sufficient to give an idea of the plants and their relationships to other species. Both plants are certainly closely allied together and belong to undescribed species, so I give as complete a description as I can from the materials.

*Shorea collina, n.sp.* Balan Bukit.—A big tree with black branchlets, leaves oblong, shortly cuspidate base rounded, above smooth grey when dry, beneath cinnamon brown, nerves ten pairs elevated beneath with net-like conspicuous reticulations, blade 5 inches long 2 inches across, petiole black, rather stout, 1¼ inches long. Panicle of flowers rather lax, 3 inches long. Rachis covered with minute stellate hairs. Flowers shortly pedicelled, sepals orbicular, ovate, white silky, fringed with longer hairs on the edge. Petal oblong, linear, obtuse, twisted half an inch long, the outside white silky, inside glabrous, stamens 20 small outer ones with a broad oblong filament, another elliptic with a single process on the back with two or three cilia, inner ones longer, with a broad oblong base narrowed abruptly into a slender filamentous portion as long as the anther, which has a single process on the back ending in two cilia, ivory conic silky hairy style, short cylindric longer than the stamens, fruit unknown.

Obtained on hills on the east coast Pahang. Sanger Davies.

In foliage this does not resemble any other of our species of Shorea. In the form of the stamens it is distinctly like *Shorea robusta*, "Sal" of Burma, as also *S. utilis* King, the Dammar Laut, of Province Wellesley.

*Shorea materialis, n.sp.* Balau Betul.—The branchlets are black. The leaves ovate with a broad base 5 inches long and 3 inches wide. (I have also leaf specimens probably of this in a young

state, 9 inches long, and 5 inches across terminated by a long cusp), coriaceous above, smooth polished grey when dry beneath, similar in colour, but silvery scaly, nerves obscure above and slightly sunk, beneath elevate 10 to 12 pairs; petiole 1 inch long, scurfy, scaly. Panicle 3 inches long, white scurfy, with short branches, pedicels 1/8 inch long. Sepals in young fruit oblong, obtuse, silky, in half ripe fruit linear, oblong, red, pubescent 4 developed 1 inch long 1/4 inch wide, ovary conic, silky.

This, which gives the best Balau timber, was found growing near the sea coast at Kuala Balak and Kuala Rompin by Mr. Sanger Davies.

It resembles to a considerable extent the other species, and it is possible that the two plants may be the same. The broad based leaf is very unusual in our species but it closely resembles that of *Shorea robusta*.

As timber trees the Shoreas may be divided into two classes—(1) the Serayah class with soft red resinous wood not at all durable and as house furniture very liable to the attacks of the house termite *Calotermes domestica*. To this group belong such species as *Shorea leprosula, viz., S. macroptera*, etc. The name Meranti which properly speaking belongs, I believe, to species of *Hopea* is often nowadays applied to inferior grades of Serayah; (2) the Dammar Laut series, a few trees with a very much harder deeper coloured high class timber, the type of this group is *Shorea utilis* King. Dammar Laut number Satu. The Balau timber is much nearer allied to this, dark hard close grained with fine rays, pores numerous but not too many.

It seems rather remarkable that in a single genus, there should be such a distinction in the timber while at the same time there seems to be no other correlation between the plants except that the stamens in *S. utilis, S. robusta* and *S. materialis* are similar in possessing ciliated appendages.—(*By H. N. Ridley in the Agricultural Bulletin of the Straits and F. M. S.*)

## TIMBER RESOURCES OF THE WORLD.

A correspondent contributes the following article to the *Times* Financial and Commercial Supplement of July 8th:—

For years the *Savants* of all nations have been foretelling the approaching extinction of the world's forest reserves, but, with one or two exceptions, little apparent effect has been produced on the policy of Governments respecting afforestation. At the first glance the areas under timber appear so enormous that, as in the case of the predicted coal famine, a certain amount of scepticism has been bred as to the grounds for those doleful prophecies; while the heavy initial expense of afforestation, reform also stood in the way of energetic action. The immensity of the subject makes it exceedingly difficult to obtain anything like exact statistics, but such rough figures as are available make it abundantly clear that those unappreciated predictions rest, at any rate, on some basis of fact. The most important commercial timbers of the world are obtained from the coniferous trees, which are to be found mostly in the North of Europe and in North America. The great bulk of the imports of all large timber-consuming countries consists of those woods, with the result that the available sources of supply are being steadily narrowed. There may now be said to be only six countries in a position to supply unlimited quantities of merchantable timbers—*viz.*, Russia (including Finland), Austria-Hungary, Norway and Sweden in Europe, and Canada and the United States in America. Of these the reserves in the United States, Russia proper, and Austria-Hungary are now seriously threatened by the rapid growth of their own requirements consequent on the natural increase of the population, while in Norway the reaping of the timber crop has been so wasteful as to bring exhaustion within measurable distance. The resources of Finland are still large, as are also those of Sweden; while Canada now represents the world's great reserve.

### INCREASED CONSUMPTION AND PRICES.

It was Colbert who said, "France will perish for want of timber," and, were it not for the marvellous adaptability of the human

race, this might now be said of the world as a whole. That the approaching virtual exhaustion of the forest resources of the universe, constitutes a very serious question cannot, however, be denied whatever, the degree of faith in man's ability to provide himself with "something just as good." It might have been thought that the substitution of iron and steel, stone cement, and other materials too numerous to mention for timber in modern constructional work would have placed a check on the consumption of the latter, but experience has shown that this is not the case. The demand has developed ever more rapidly, and the ratio of increase has been largely in excess of that of the population. Thus, while in the concluding 40 years of last century the population of Great Britain increased by about 42 per cent., the imports of timber were trebled ; and in a circular issued by the Forestry Department of the United States it was stated that the proportionate increase of population since 1880 was only half of the proportionate increae in the consumption of timber during the same period. Even in a great timber country like the United States the consumption is three or four times what the country produces. If further evidence of the steady increase of the consumption, as well as of the depletion, of the reserves be needed is to be found in the fact that during the past few years values have steadily appreciated. Pine, for instance, has doubled in price. In the last five or six years teak has advanced in value by 50 per cent., while American black walnut is almost unobtainable at any price. A competent authority, giving evidence before the Royal Commission on Coast Erosion, said that imported timber had doubled in value during the previous 20 years, and the price of forests in Sweden, Canada, and the United States was ten times higher. These were the statements of a man actively engaged in timber-cutting in widely-separated parts of the globe. Pressing upon the Commission the necessity for the immediate adoption by the State of an extensive scheme of re-afforestation, he hazarded the prediction that in less than 30 years the £30,000,000 worth of timber now imported into Great Britain would cost £60,000,000 or £90,000,000, if it could be got at all. From considerations such as these it is clear

that even in these days timber is one of the most useful materials known to man, and is not likely to be superseded so long as adequate supplies are available. Largely owing to its bulk the cost of the labour involved in the felling, transporting, and manufacturing of wood is very great—being roughly equivalent to its first cost—and the rapid destruction of the forests contiguous to ready means of transport and the steady rise in wages have been important factors in increasing its value. The owners of standing timber are awaking to the great potentialities of a large timber area, and are no longer willing to sell at practically any price that may be offered by the merchant. It has been seen from the evidence submitted to the Royal Commission on Coast Erosion that forest values have increased tenfold, and it is extremely probable that since that evidence was given there has been a further appreciation.

### AREA UNDER TIMBER.

As already indicated, the European countries with a large surplus available for export are Austria-Hungary (with which may be coupled Bosnia and Herzegovina), Russia (including Finland), and Sweden and Norway. From all of these countries, with the exception of Austria-Hungary, Britain imports largely of timber for constructional purposes, and our interest in the depletion of their forest reserves is no mere academic one. By far and away the largest forest reserve in Europe is now existing in Russia and Finland, which have between them over 500,000,000 acres under timber. Austria-Hungary comes next, but a long way behind, with 50,000,000 acres, Sweden following with 48,000,000 acres, Germany with 34,000,000 acres, France with 23,000,000 acres, Spain with 20,000,000 acres, Norway with 17,000,000 acres, and Italy and Bulgaria each with 10,000,000 acres. Those represent widely varying percentages of area under forest, ranging from 44 per cent. in the case of Sweden and 40 per cent. in the case of Russia to 14 per cent. in Italy. But even the least of those figures is large when compared with Britain's very modest 4 per cent. The proportions of area under State ownership also afford n interesting comparison, being as high as 84 per cent. in the

case of Spain and as low as 7 per cent. in Austria, the figures for the other principal countries being as follows:—Russia, 61 per cent.; Bosnia and Herzegovina, 70 per cent.; Germany, 33 per cent.; Sweden, 27 per cent.; Hungary, 16 per cent.; and Norway and France each 12 per cent. With the four exceptions named all the European countries are larger or smaller importers, particularly of light pines and firs, of which over 80 per cent. of Great Britain's imports consists. At one time Germany was a large exporter, but during the last 30 years or so its position has been reversed, and it now imports 25 per cent. of its supplies notwithstanding a huge increase in the domestic production. Austria-Hungary and Norway and Sweden have borne the brunt of the European demand for the last 60 years, and continue to do so, but with the exception of the first-named countries it is difficult to see how they can do so for many more years. In Russia, particularly Siberia and Finland, there are still, however, large virgin forests, but at present they may be regarded as without the pale of practical politics in view of their inaccessibility, and it is estimated that the value of timber will have to advance by at least 200 per cent. before it will pay to cut them down.

### VALUE OF BRITISH IMPORTS.

Our own point of view is, of course, the most important for us, and looking at the problem in that way deprives it of none of its seriousness. Last year the total value of the timber imported was £23,591,000. About a quarter of this was represented by hewn wood, *viz.*, £5,783,000, of which £2,928,000 was in respect of pit props and wood, leaving £2,855,000 as the value of the hewn fir, oak, and teak. Wood, sawn or split, planed or dressed, accounted for £15,469,000, furniture woods, hardwoods, and veneers for £1,792,000, and stays for £546,000. Leaving out of account the pit props, furniture wood, and staves, it is found that the total value of the shipments from Russia was £7,228,000, from Sweden £2,578,000, and from Norway £1,286,000, while Canada was drawn upon to the extent of £3,304,000, and the United States for £2,652,000 worth. When against those figures

is placed the £5,000,000 or £6,000,000 at which the British domestic production of timber is valued, the extent of our dependence upon foreign supplies will be realised. Those who hold that the bulk of our requirements, notwithstanding the alleged superiority in quality of foreign timbers, could be grown at home state that those needs could be fully met from a part only of the 20 odd million acres of land now lying waste and suitable for planting.

SUPPLIES IN THE UNITED STATES.

The eyes of the world are now directed to North America in their search for future timber supplies. The area of land under forest in the United States is prodigious. The total amounts roughly to 700,000,000 acres, of which nearly 150,000,000 acres are under State management of control. Estimates naturally vary widely as to the actual reserves of merchantable timber, the Government census of 1900 putting the stand at 1,390,000,000,000 ft., board measure, while two years later Dr. B. E. Fernow, of Toronto, estimated it at 2,000,000,000,000 ft. This latter figure was substantially corroborated by the *American Lumberman* in 1905; but a conservative estimate by a well-informed correspondent, which appeared in the *Times* at the close of 1908, put it at 1,500,000,000,000 ft. Though it is almost impossible for the lay mind to realise what these figures mean, attempts have been made to place a value on the timber, the figure which is generally accepted by competent authorities being roughly £4,000,000,000. It might at the first glance be concluded that such figures represent a practically inexhaustible reserve, but the statistics of consumption, which are naturally more precise, are quite as impressive, and speedily dissipate anything akin to complacency as to the future. The present lumber cut amounts to 38,000,000,000 ft., and is increasing at a truly remarkable pace. The rapid growth of the population would, of course, prepare one for an increase in the timber consumption year by year, but the actual rate of increase has been very much in excess of what might reasonably be looked for on that basis. Between 1880 and 1900 the growth of the population amounted to 52 per cent., but in the same period the

output of domestic timber increased by 94 per cent. The output in the first-mentioned year was 18,000,000,000 board feet and since that date the quantity put through the mills of the United States totals 800,000,000,000 ft. The exports to Europe amount to between £8,000,000 and £9,000,000 per annum, but, on the other hand, over 80 per cent. of the timber exports from Canada go to the United States. From these figures it follows that without taking into account the growth of new forests, the available supply of merchantable timber would be exhausted in 40 years, and even taking such growth into consideration 60 years would appear to be the furthest limit of the duration of the timber supplies. Happily, there are indications that the public conscience is being awakened to the obligation which rests upon the community to make good as far as possible the enormous annual wastage and not only are the forests being to some extent conserved, but efforts are being made to reduce the absolute waste which even yet is estimated but little short of a quantity equivalent to that actually utilised. Under the best of conditions, however, it is becoming increasingly plain that the time when the United States will have timber to spare for foreign consumers is fast drawing to a close.

### POSITION IN CANADA.

Turning to Canada as apparently the last resource of timber importing countries, it must be confessed that even here the generally accepted figures are not too re-assuring. Canada's stand of merchantable timber is put at a considerably lower figure than that of the United States, being, in fact, rather less than half. It is not unlikely, however, that all hitherto accepted estimates will prove to be under rather than above the mark. The forests in British Columbia are very extensive, the stand being estimated at between 150,000,000,000 ft. and 200,000,000,000 ft. Canada's total forest area has been placed at 1,250,000 square miles. or 38 per cent. of the total area. There will be ample reserves in Canada to draw on for many years to come, as there is not the same enormous domestic consumption in that country as in the United States but this may not operate very effectively in the direction of checking

the upward tendency of values as already the timber contiguous to convenient waterways, such as the St. Lawrence and its tributaries, is being rapidly cleared, and obviously the cost of transport will increase very appreciably as it becomes necessary to go further inland and northwards for the supplies. It must not be assumed that the timber used by man represents the whole of the consumption. The destruction through forest fires and wind storms is incalculable. Little can be done to mitigate the effects of the latter, but the former can be combated with more prospect of success. The steps taken in this direction so far are totally inadequate, but there is ground for hoping that in the next few years more satisfactory progress will be made, both as regards the preservation of the remaining forests and the replanting of the depleted areas.—(*The Times.*)

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## THE FOREST RANGER.*

Revenue maker from Forest produce of various sorts,
Soil Improver and Wood grower according to Forest Arts,
Manager of Fellings, sowing and planting round,
Protector of timber, fuel and grasses ground,
Improver of Government waste, and oosa lands,
Binder of Hill slopes and the shifting sands,
Hard worker in Forest Departments of Hills and Plains,
Earnest Protector of Government interest in wind and rains,
Prosecutor and Lawyer in courts of the country laws,
Defender of Government interest from culprits' jaws,
Surveyor, Clerk, Mapper and Draftsman,
Engineer, Accountant, Ranger and what else he can,
A unit on which a whole Division is hung,
A guide whose praises among the people sung.
But alas a stroke unmerited from his superior's pen,
Darkens all the meritorious deeds he done,

* A plea for promotion by seniority extracted from an anonymous petition recently submitted to the I. G. of Forests.

Condemned unheard he stands aghast,
No voice he has to bring to light what past,
Will your honour redeem the Ranger from wrong,
Or shall the latter remain to suffer throughout his service long.
Servant of the above description, useful to the State,
Requires protection, deserves attention, and care at any rate.
With folded hands he humbly prays your honour's life be long
Promote the senior, allow appeals, redress unmerited wrong.

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## NOTES.

**Gyrocarpus americanus.**—A sample of this wood has recently been tested by Mr. A. Roller of Berlin as regards its suitability for match boxes and splints. He reports that the wood can be worked well, and that it is an excellent wood for box-skillets. It can be used also for splints, only the colour of the wood is not very suitable as it is too dark. He remarks however that it is possible that the wood has become discoloured and that the splints would have a better appearance if the wood were worked in a fresh state.

**Fibre from Calotropis gigantea.**—A correspondent enquires whether any one can give him information regarding a machine suitable for extracting fibre from the *green* bark of this plant. The fibre is very valuable and has at present to be extracted by hand. If the plant is allowed to dry or is soaked in water the fibre deteriorates. If a suitable decorticator could be found the industry might be greatly developed.

**Turpentine.**—The market for turpentine has been steadily advancing and the gain in American spirits totals about 2*s.* per cwt. French sellers of turpentine discovered that they were offering their material unnecessarily cheaply, and have advanced the price by about 4*s.* per cwt. so that the difference between the two kinds is now only 2*s.*, which is perhaps scarcely enough to induce consumers to buy much French spirit. Russian spirit is practically unchanged for the best kinds, although inferior qualities are about

6*d.* per cwt. dearer. Substitutes are sold at the same range of prices as before. There appears to be every chance of reaching 60*s.* for American turpentine before the spring is over; and nearly 59*s* has already been paid for forward delivery. The import figures and prices for five years are as follows :—

| | 1906. | 1907. | 1908. | 1909. | 1910. |
|---|---|---|---|---|---|
| Imports ... | 512,836 | 510,308 | 573,674 | 443,375 | 472,247 cwt. |
| Price ... | 50*l.* 5*s.* | 32*l.* | 29*l.* | 40*l.* 15*s.* | 55*l.* 15*s.* |

VOLUME XXXVII NUMBER 5.

# INDIAN FORESTER

*MAY, 1911.*

## OURSELVES.

After a lapse of some years the *Indian Forester* has returned to its first home at Dehra Dun.

We wish to take the earliest opportunity of expressing our thanks, and in this we are confident that all members of the Department will join us, to Mr. P. H. Clutterbuck for the able manner in which he has carried on the duties of "Editor" during the last four years. In addition to his own work which we happen to know has at times been very heavy, he has taken upon himself the somewhat onerous duties of "Editor" of our Journal, and I think, it must be admitted, with the happiest results. We feel that we owe him a debt of gratitude.

Our notice has more than once been drawn to the fact that one of the chief difficulties that besets the Editor is the very limited amount of material supplied by the Department. This is not as it should be. We take this opportunity of cordially inviting all members of the Department and others who take any interest in the *Forester* to send us in their articles and invite correspondence on all subjects of interest. If members of the Department withhold

their assistance, as has too often been the case in the past, there is the danger present that the issue of the *Forester* will be restricted and that it may be forced to appear as a quarterly in place of a monthly. Should this happen, no one will regret it more than ourselves ; at the same time it is as well that all should recognise that this restricted issue will not be due to want of energy on the part of the Editor and those co-operating with him but rather to the apathy of members of the Department. We therefore hope that articles for publication will come in freely embodying the observations, scientific or otherwise, of various officers. We hope to be able to find a place for all material of interest that may be sent us by correspondents, provided of course that such is temperately expressed so as to avoid wounding the feelings of individual members of the Department. We should like to state that in future the Editor will be the President of the Research Institute and College assisted by the staff at Dehra. To the former all communications should be addressed, which as usual will be regarded as confidential, while the names of correspondents will be in no case divulged if they wish to write anonymously, to which there is no objection, though it should be borne in mind that a signed article, or a letter signed by the name of its writer, generally carries more weight than an anonymous one.

The fact that so many Government officers now take in the *Forester* evinces the interest that is officially taken in it, on the other hand it must be noted that the number of private subscribers appears to have decreased. It should be remembered that the Journal is not an official one, and that it does not necessarily embody in its articles what may or may not be thought to be an expression of official opinion. Its financial position at the present moment is not bad, though not entirely satisfactory, and in a short time we trust that we will be able to show a balance on the right side. Until this is done it may be that the number of illustrations, the cost of producing which is high, may have to be curtailed, though we trust that this will only be temporarily.

We now look to the Department for continued and extended support, and have little doubt that we will not have to look in vain.

# PAPER-PULP TESTING AT THE FORESTRY COURT CELLULOSE LABORATORY, ALLAHABAD EXHIBITION.

By W. Raitt, Part III—Grasses, Etc.

Bhabur, Baib or Sabai grass, (*Ischæmum angustifolium*). This grass is now the leading staple of the Indian Paper Mills, so its capacity for producing pulp is well known. At present its exploitation is limited to districts within economic transport radius of the Mills. It does not, on the average, yield more than 40 per cent. of unbleached pulp, hence transport charges on 2½ tons of grass are incurred on each ton of paper produced from it. Added to this is the additional transport loss due to its bulky nature, which, even in pressed bales, permits only half the carrying capacity of a railway wagon to be used. The present difficulties of the Indian paper industry are largely due to these circumstances. The Mills have long since reached the utmost limits of profitable collection of this material, and are even importing wood-pulp from Europe to eke out their supplies.

The question of reducing this grass to pulp *in situ*, at or near the producing districts, does not appear to have received the attention it deserves. The economy effected in transport to the paper mills of one ton of pulp producing nearly one ton of paper, in hard-pressed bales of which full wagon capacities can be carried, is obvious : and it would seem desirable that enquiries be instituted in these Provinces and others of Northern and Central India, with the object of suggesting suitable manufacturing sites and collecting information as to the supplies available in their neighbourhood.

The grass is comparatively easily reduced to pulp with 15 per cent. of caustic soda, and bleaches to a brilliant white with 10 per cent. of bleaching powder, calculated on the air-dry weight of unbleached pulp. The yield of pulp (unbleached) of the samples tested was 43 per cent. but these were of unusually good quality, cut *just previous to flowering, at which stage it is at its best for* cellulose. The average, over a whole season's crop, would be about 40 per cent.

Almost exactly similar remarks to the foregoing may be applied to Munj (*Saccharum Sara*), which was at one time also

largely used by the local mills, but the transport cost over long railway hauls has now almost squeezed it out. It costs slightly more for reduction—about 17 per cent. of caustic soda—than bhabur, but gives a slightly better yield, averaging 42 per cent. Its bleaching qualities are similar to bhabur.

'Ulla' grass, from the Terai (*Anthistiria gigantea*). The sample had been cut after the ripening of the seed and the lignification of the fibre. This considerably reduced the yield, which was 37 per cent. If cut prior to seed production, its yield would be about 40 per cent. It reduced to pulp with 18 per cent. of caustic soda and bleached to a brilliant white with $10\frac{1}{2}$ per cent. of bleach. In quality, it is tough and strong. There appears to be no doubt as to immense quantities of this material being available, and I understand it is at present of no economic value whatever, not even for fodder. Its inclusion now amongst potential paper supplies may be claimed as a new discovery, as it has never previously been suggested for this purpose. If it can be shown to be associated with the necessary manufacturing conditions, it is well worth serious attention.

Kaing grass (*Phragmites Karka*). The sample was forwarded from Burma by Mr. Pearson, Imperial Forest Economist, at the request of the Inspector-General, Mr. Beadon Bryant. It arrived in a rather mildewed and blackened condition which obviously affected its yield, which was only 34 per cent. It proved to be easily reduced with 16 per cent. of caustic soda and bleached to a brilliant white with 12 per cent. of bleach. In a good sample I estimate the yield to be from 38 to 40 per cent. In colour, strength, and toughness, it is very similar to 'Ulla' pulp, and one of the best grass pulps I have seen. If available in sufficient quantity and under good manufacturing conditions, it is well worth further enquiry.

Generally, these grass pulps are of superior quality and value to the wood pulps and may be produced at less cost.

Bamboo. Although much interest is being taken in the exploitation of bamboo for pulp, it is not likely to become a live question in these Provinces, where its occurrence is limited in comparison

with Burma, and where a good local market already exists for building and other purposes. It was not, therefore, included in the scheme of the present enquiry, but the success of sulphate treatment in dealing with colour difficulties of the woods, alluded to in previous article, suggested a new line of experiment for bamboo. It has hitherto been dealt with by sulphite and soda treatment, both of which produce excellent results in all respects but that of colour and bleaching. Dr. Richmond of the Bureau of Science, Manila, has been able, with Philippine bamboo, to get good colour results with soda treatment, but so far, with Indian species, experiments have not been wholly satisfactory. The ordinary course of this enquiry was, therefore, suspended long enough to enable some conclusion to be arrived at as to the effects of sulphate treatment, in the hope that a new line of research for a future occasion might thereby be suggested.

A close comparison of the colour difficulties found, under soda treatment, in the case of woods like *Salix tetrasperma*, with those shown by bamboo, seemed to reveal several points of similarity; and when a sample of bamboo soda pulp, washed with hot and cold water until no further colouring matter was extractable, was treated with a weak solution of sodium sulphide, a strong infusion of dark-brown colouring matter resulted. This, when washed out, left the pulp several shades lighter in colour and easily bleachable. Some further experiment was necessary to determine the proportions of hydrate and sulphide suitable. The species experimented with was *Cephalostachyum pergracile*, and, for it, three of the former to one of the latter gave the best results (with *Salix* it was 6 to $2\frac{1}{2}$). Two digester experiments with one and two-year-old culms were therefore conducted with sulphate liquor in these proportions, and containing a total alkali ($Na_2O$) of $6\frac{1}{2}$ per cent. (for *Salix* 7·4 per cent. was necessary). The results were a brilliant white with 8 per cent. of bleach for the one-year-old and 10 per cent. for the two-year-old—colours impossible to obtain with less than 20 per cent. in the case of soda pulp. Further, the unbleached colour was particularly good—good enough without bleaching for many of the unbleached papers used in this country. In both

cases the samples were dealt with *all in*—nodes and all—with no deleterious effects on the pulp. It was found that thorough crushing of the raw material prior to digestion solved the node difficulty. Hitherto it has been deemed necessary to cut out and reject these. Of course, it remains to be seen whether these results will hold good with other species and with older culms of the same species. It is intended to continue this line of research at the Forest Institute, Dehra Dun, after which further information will be available.

The nett results of the whole enquiry may be tabulated as follows :—

*I. Negative results.*—Woods rejected as unsuitable for pulp manufacture for one or more of the following reasons—(*a*) insufficient yield, (*b*) too weak and short in fibre, (*c*) cost of chemical treatment too high, (*d*) unbleachable colour, (*e*) logs too small or too irregular and fissured in outline to pay for barking :—

*Odina Wodier*, *Anogeissus latifolia*, *Terminalia belerica*, *Mallotus philippinensis*, *Celtis australis*, *Heloptelia integrifolia*, *Morus* (all species), *Garuga pinnata*, *Litsæa sebifera* and *L. polyantha Casearia glomerata* and *C. tomentosa*, *Cordia Myxa*, *Ehretia lævis* and *E. acuminata*, *Phœnix sylvestris*, *Chloroxylon Swietenia*, *Cochlospermum Gossypium*.

*II. Positive results.*—As the enquiry proceeded, it was not found advisable to adhere too closely to the rule of 40 per cent. yield, 20 per cent. soda and 15 per cent. bleach. Cases were found when the yield was slightly less, but was counterbalanced by a corresponding economic reduction in soda or bleach, or both ; and in other cases a higher cost in one or both of the chemical factors was recompensed by a higher yield. Those in the following list may therefore be described as " Economic Pulp yielders." The term has no reference to quantity available, conditions and place of growth, transport or other subsidiary manufacturing factors, but is used only to describe those which fulfilled the primary requirement of an *economic average* of the stipulations of the above rule.

They are grouped in classes according to their general characteristics, and in each class the members follow each other in order

of quality. Those of equal quality are bracketed together. Those not of special interest to these Provinces are printed in italics.

*Class A, Grasses.*—Moderate length of fibre, but generally tough and strong. Capable of bleaching to brilliant white. Suitable for high grades of writing and printing paper.

1. *Anthistiria gigantea* (Ulla).
   *Phragmites Karka* (Kaing).
2. *Ischœmum angustifolium* (Bhabur).
3. *Saccharum Sara* (Munj).
4. Bamboo.

*Class B, Coniferous Woods.*—Pulps of great length and strength of fibre. Rather harsh in nature and lacking in toughness. Bleachable to good white. Suitable for second grade writing and printing papers, or for admixture to give strength to inferior pulps.

1. *Picea morinda* (Spruce).
2. *Abies Pindrow* (Silver fir).
3. *Pinus longifolia* (Chir pine).
   *Pinus excelsa* (Blue pine).

*Class C.*—Mostly deciduous woods of mixed forest. Moderate length and strength. Soft, pliable and fairly tough. Mostly of fair bleaching quality. Suitable for second grade writing and printing papers.

1. *Bombax malabaricum.*
2. *Populus ciliata.*
   *Sterculia villosa.*
3. *Trewia nudiflora.*
   *Spondias mangifera.*
4. *Salix tetrasperma.*
5. *Butea frondosa.*
6. *Boswellia serrata.*
7. *Ficus bengalensis.*

*Class D.*—Woods as class C. Short and weak in fibre, but of good "bulking" properties. Easily bleached to fair white. Useful for admixture with stronger pulps.

1. *Grewia* (all species).
2. *Kydia calycina.*

In the case of mixed forests where any single species might be insufficient in quantity to supply a factory, all the members of classes C and D could be called upon to make up the total required. They can all be dealt with by the sulphate method. It might not be advisable to mix them in treatment, but there would be no difficulty in running the mill for, say, a week on one species and a week on another, and so on. General conclusions based solely on results obtained from those species of special interest to these Provinces, and from such limited information as is available respecting their quantity and distribution, and exclusive of considerations relating to transport, manufacturing sites and facilities :—

*1st.*—That these Provinces appear to possess reserves of paper making material so enormous in the aggregate as to be beyond even approximate estimation.

*2nd.*—That there are no chemical or chemical engineering difficulties in the way of their conversion to pulp.

*3rd.*—That the grasses (class A) produce pulps of a value sufficient to raise hopes of their exportation beyond India.

*4th.*—That the *Coniferæ* (class B) produce pulps fully equal in quality to those now manufactured from similar species in Europe and America, and the rapidly growing scarcity of pulp-wood in these countries may at no distant date open an export market for them. That *Picea morinda* (Spruce) stands out *facile princeps* as the wood for conversion into pulp by the mechanical (grinding) process wherever it is found associated with water-power, and for such pulp a market is already open in this country.

*5th.*—That while classes C and D may, for the present, be overshadowed by the greater importance of A and B, they may be regarded as valuable reserves of material against the time when scarcity elsewhere raises their value, or improved rail and canal communication reduces their cost of exploitation.

*6th.*—That the species which possess the best claims to early and profitable exploitation are 'Ulla,' Bhabur and Spruce.

I have to acknowledge in the warmest terms the great help I have received from Mr. P. H. Clutterbuck, I.F.S., the Director of the Forestry Court, to whose initiative the whole enquiry is due. His unique knowledge of forest products and the sympathetic interest with which he directed the investigation have been of the greatest possible assistance.

## MEASURES FOR THE DESTRUCTION OF MOTHS PREDACEOUS ON LAC.

In Mr. Stebbing's "Note on the Lac Insect, its Life History, Propagation and Collection," 2nd edition, p. 22 (*Indian Forest Memoirs*, Vol. I, Part III), the author recommends, as the only means of checking the damage done to lac by predaceous moths, the following drastic measures:—"When the lac cells are seen to contain large numbers of these caterpillars on any particular tree or series of trees the whole of the lac-bearing branches should be cut off and burnt at the periods when the cells are seen to contain caterpillars and before the caterpillars have changed into moths. This would get rid of the moth pest and prevent it spreading and committing damage on a large scale in the lac areas. Beyond this somewhat drastic method of checking the pest it is impossible to go at present." Doubtless the measures proposed will prevent the spread of the pest, but it is even more certain that they will also succeed in exterminating all the lac in a good many localities where its cultivation is practised, for it is seldom that lac is to be found free from caterpillars, however promising the crop may be.

Judging by what is so far known of the life histories of the moths concerned, a more practicable and less destructive means of checking the pest would appear to be possible. It has been noticed in the case of specimens of (1) Kussam (*Schleichera trijuga*) lac collected in Raipur, C. P., (2) lac from the Garo Hills, Assam, and (3) Dhak (*Butea frondosa*) lac from Siwalik Division, U. P.,

that at the time when the young lac insects swarmed out at the beginning of the cold weather there were predaceous moths in the larval and pupal stages in the lac. In the case of (1) the moth in question was *Hypatima pulverea*, Meyr. The other two have not yet been determined, but the Siwalik moth is possibly *Eublemma amabilis*. In each case moths commenced emerging after the swarming of the lac insects, and in some cases continued emerging for two or three months after. In the case of the Siwalik moth (*Eublemma ?*), the moths commenced emerging only a few days after swarming of the lac.

An obvious means of checking the spread of the predaceous moths concerned, and possibly exterminating them locally, would therefore be to collect *all* the lac immediately before the swarming, tie up what is required for seed lac, and as soon as the lac larvæ have swarmed out remove all the seed lac from the trees. All lac collected, whether before or after the swarming of the larvæ, should at once be removed, steps being taken to prevent all chance of the moths emerging and escaping. The drying of the lac might possibly be done under moth-tight gauze screens, or the lac may be fumigated with carbon bisulphide as described by Mr. Maxwell Lefroy in the *Agricultural Journal of India*, Vol. III, p. 176.

From the above remarks it will be seen that any system of cultivating lac whereby any lac is left on the trees, even for a short time after the swarming of the lac insects, will tend towards the spread of predaceous moths. Until the life histories of the various moths have been further studied it is impossible to say whether the measures proposed will lead to the eventual extinction of the predaceous moths locally, but there is little doubt that it will check their spread whenever the emergence of the moths follows the swarming of the lac insect. These measures are now being tried experimentally on a considerable scale near Dehra Dun, and the results, if successful, should be apparent after one or two seasons. Needless to say, any promiscuous cultivation of lac in the neighbourhood of the areas set apart for its cultivation on the lines suggested above will to a large extent nullify any prospect of eradicating the

predaceous moths, so that the areas selected should be isolated ones.

DEHRA DUN: R. S. TROUP.

*14th March* 1911.

## A FRIENDLY LUNGUR.

SIR,—The Hanuman Monkey (*Semnopithecus entellus*), or the monkey general of the great Hindu epic, is a representative of the group of the old world monkeys—Catarrhinæ. It is generally found almost all over India, but seems to have made its home chiefly in Central and Northern India. The Lungur by which name it is popularly known in India, always likes to live in forests or highly-wooded districts; it also sometimes haunts groves near towns. As a rule, this animal lives in colonies, but the two sexes have their own separate troops led by full-grown males who act as commanders. At the beginning of the winter season, probably the season of its rut, the colony of males attacks the neighbouring colony of females, and a great struggle ensues, when the vanquished, if they continue in a good condition, snatch away the young males from the charge of the females and establish a colony for themselves. But if the defeated are permanently invalided and unable to lead their newly-found group, they are left to their own fate, and it does not unfrequently happen that such fallen commanders soon end their miserable existence.

Last winter in a village bordering the forest of Arvali Hills one evening some of the village idlers suddenly saw a big lungur apparently struggling to find his way out of a gully bordered on

both sides by thorny hedges. According to its natural habit the animal instead of going straight by open path, wanted to get into a covert but was repulsed by the piercing thorns of the fence. This last fact, together with the hesitating pace of the animal, gave a clue to the on-lookers, who came to the conclusion that the animal was blind. It being held sacred by all classes of people in this country, the villagers felt pity for the unfortunate creature and one of them, a confectioner by profession, desired to take charge of it and feed it. It was then driven to the village confectioner's shop by two persons, shouting on each side, thus guiding the animal between them. After reaching the destination, it was seated in the verandah by the side of the sweetmeat stall, and was offered some eatables, which it promptly accepted. From this day the Lungur was regularly fed by the confectioner and was found to value human friendship. It passed almost the whole day and night at the sweetmeat shop, and was amicably disposed towards the boys of the village.

A few days after, when I camped near the village, my orderlies came and told me the history of this Lungur, and asked my permission to fetch the animal to my camp, so that I might see it. I allowed three of my men to go and get it. My orderlies being unacquainted with the strength of the animal, tied a rope round the waist of the animal and began dragging it out of its new home. After they had pulled the unwilling beast a few paces, it felt very uneasy and seemed to dislike bondage, so much so, that it gave a strong jerk and dashed the men flat on the ground. Giving up the idea of bringing the animal captive, they acted on the advice of the confectioner, and conducted it to my tent only by shouting. As it came and sat by my tent, I found that the animal was very large and strong. Its canine teeth were long and pointed and quite capable of being effectively used for inflicting wounds on its adversary. Observing closely, I noticed severe wounds all over its face, the delicate cornea of the eye also not having escaped. The dirty reddish lines of dried blood running vertically downwards gave evidence of the animal's having bled to an unusual extent. The eyes were badly ruptured and this circumstance was responsible for the accidental blindness of the animal. Now, since the

organs of sight lost their functions, the optic region and its connecting nerves, having no legitimate work to do naturally contributed to the general increase of the power of thinking in the animal. The Lungurs are always described as most wild and distrustful and can scarcely be made friends with, but the above-mentioned peculiar circumstances proved a strong agent to modify the wild nature of the Lungur.

The village boys probably with a view to revenge themselves on the usual mischief of the Lungur, used to pat its head, and deceitfully placed clods of earth and lumps of rubbish in his hand, which it extended like a mendicant at the very smell of man. This sort of ill-treatment never exasperated it. Every unpleasant joke it patiently swallowed, leaving aside its characteristic nature. All this went to show that the blindness effected a great development in the thinking power of the animal. It clearly understood its changed position and became completely submissive to man.

GAROTH, *Indore State.*

A. B. PUNDE: *Divisional Forest Officer.*

## * SCHLICH'S MANUAL OF FORESTRY, VOL. III, 4TH EDITION.

The fourth edition of Schlich's Manual of Forestry, Vol. III (Forest Management), has just appeared, and although it differs little from the previous edition in general arrangement, certain improvements in the text, as well as minor additions and alterations, are noticeable. The examples, for instance, are now printed in small type, while the printing of the headings throughout the text is done in clearer type than in the 3rd edition: some additional examples have also been included where necessary.

Among the more important additions in the new edition are the series of diagrams on pages 206, 214, and 218, illustrating the appearance of a forest having a normal series of age-classes arranged in one and in five cutting series respectively, and the ideal appearance of a wood worked under the system of coppice with standards. These diagrams, which are of the same nature as those published in the latest edition of Vol. II of the Manual, give a very clear conception of the subjects illustrated.

Regarding the general applicability of Forest Mathematics to Indian Forestry in its present state of development, opinions appear to differ. No doubt many of the complex formulæ which appear in the volume under review are not capable of practical application in India at the present time, but it cannot be denied that with the rapid strides made in Forest Management, in some parts of India at least, the value of mathematical formulæ as an aid to profitable working is certain to be appreciated more and more as time goes on. Already we are aware of forests in India which have been worked systematically for some time, for the profitable working of which it is now advisable to calculate the financial rotation and work accordingly. Again, we have known of more than one instance where the careful calculation of the expectation value would have saved considerable loss in the case of planting with the idea of profit and in the case of the purchase of existing forest with a view to making a profitable income from it.

* Schlich's Manual of Forestry, Vol. III, Forest Management, by Sir. Wm. Schlich K.C.I.E.—4th Edition, 1911. London, Bradbury Agnew & Co., Ltd., 10, Bouveri Street.

Hitherto doubtless the absence of reliable statistical *data* has been a bar to the extensive use of mathematical formulæ as applied to Forest Management in India, but in time it is hoped that the statistics collected by the Forest Research Institute will lead to progress in this direction. It is perhaps not generally recognised to what extent the Sylvicultural branch of the Research Institute is indebted to Vol. III of Schlich's Manual for the manner in which statistical information is collected and tabulated. We may mention on good authority, however, that this volume forms the key-note of most of the work connected with the measurement of volumes of trees and whole woods, the calculation of increment and the compilation of form factors, at the Forest Research Institute.

We congratulate Sir Wm. Schlich on the successful issue of the 4th edition of Vol. III of his Manual.

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## NOTES ON THE SEMI-WILD CATTLE OF SRIHARIKOTA, NELLORE DISTRICT.

In the south-east of the Nellore District, there is a small island called Sriharikota, and in this island there is a Reserve Forest covering an area of 39½ square miles which abounds in semi-wild cattle.

*Habits.*—These are seen roaming about among the thick bushes and on the luxuriant grassy plains. They collect in large herds, composed of bulls, cows and their young ones.

During the day for the most part, they hide themselves in the forest. At night, they emerge from their sheltering resorts, feed on the grass and the tender leaves of trees, and with sunrise again take to their hiding-places. During the season of cultivation the crops suffer a great deal of damage, as the cattle, in their wanderings at night, eat them and tread them down, and the ryot has therefore to keep watch over his crop at night, to ensure its safety. It is a curious fact that these animals jump a 3-foot fence, and if the fence happens to be higher, they at first make a small hole in it, enlarging it until it is big enough for them to pass

through, one by one. They are afraid of man, and run on seeing human beings.

THE CATTLE AND THEIR OWNERS.

One will be led to conclude from the life led by these cattle, that they are without owners; but, as a matter of fact, almost every one of them belongs to some rich ryot or other of the village. They number about 800, and though they are owned by the villagers they are left to take care of themselves. They, however, bear a striking contrast to the domesticated cattle of the village. Living as they do in the forest, wandering freely over it, grazing on the fine grasses, and eating the tender leaves of the trees, they are far stronger and healthier than the latter and present to the eye a far finer appearance, although they are small in size.

In former days, when the forest was under the control of Polygars, the cattle of the villagers were allowed to graze freely in the forest. Whenever the owner felt the need of the services of his animals, he would catch them with the aid of dogs, and after he had done with them, send them back into the forest.

This queer practice is still prevalent in the village. Every year at the commencement of the cultivation season the required number of bulls are caught and utilized for ploughing purposes. When the season is at an end, the animals are driven away into the forest and allowed to remain there till they are needed again. Similarly with cows. Soon after a cow calves she is caught, tamed, and used for milking purposes. When no more milk is to be had from her, she is sent back to the forest and allowed to remain there till she again comes into milk. On bringing home the cow with her young one, the owner brands the new-born calf to show ownership. At the present day, there is not a single cow or bull that does not bear some such distinguishing mark. A very interesting point to note in this connection is that, in the course of a very short time, these animals become as wild as before and the mere appearance of human beings frightens them off.

When it is desired to catch these cattle, two men start with a rope and two common country dogs of ordinary size, but well trained. Possessing a keen knowledge of the resorts of these

animals, the men go into the forest and beat through the bushes where they expect them to be, with the result that all the animals scatter, thus enabling the men to follow the animal which they wish to catch.

In the course of their pursuit they let loose their dogs, which immediately chase and overtake it. One of the dogs goes to the front and checks the animal while the other remains behind. The animal, thus brought to bay, tries every possible mode of escape, taking, however, particular care all the while to keep its nose beyond the reach of dogs. The dogs, in their turn, try to stop the animal, and when the opportunity comes, seize its nose and hold it fast till the men, who are behind, come up. Sometimes by way of variety the dogs catch hold of the neck or ear or leg. When once the animal is thus caught by the dogs, it does not move till the men release it. On arriving on the scene, one of the men takes a firm hold of the tail, while the other passes the rope round the neck and makes the other end fast to the trunk of a tree. It is interesting to watch the struggle between the animal and the dogs, the former making desperate efforts to escape, and digging at them with its horns until seized.

Even after the animal is caught and tied to the tree, no one dare approach it, but it is left to itself for two or three days without food and water. If this method fails to have the desired effect, a strong bull, which has been well tamed, is brought and the two are allowed to remain together for some days ; the captured animal then quiets down. The domesticity of the animal, after it is tamed, is astonishing.

In the first year of coppice growth, the damage done by these cattle to the forest is enormous. The damage done to the plantations also is excessive. They often feed on the leaves of Neredu (*Eugenia Jambolana*), Chikereni (*Albizzia amara*), Dirasanam (*Albizzia Lebbek*). They not only tread down the plants, but also eat the leaves.

Some time ago it was the practice to catch the cattle found grazing in the closed areas and impound them, and they were released by the pound-keeper on payment of a fee of 4 annas per

head. About the year 1903, the pound fee was raised to 12 annas per head, and this is in force at the present day. This enhancement of the pound fee has not, however, succeeded in effecting any reduction in the number of impounded cattle. Two men are employed for catching any that stray into the closed areas of the reserves, and they are paid a remuneration of Re. 0-6-0 for each animal they catch and impound. On an average each man gets Rs. 6 per month. Every year from 300 to 400 cattle are impounded, but this has had no effect on the owners of the cattle. The owner, soon after he releases his cattle from the pound, lets them loose again in the forest.

T. M. NALLASWAMY NAYUDU.

31*st October* 1910.

## A FOREST FLORA OF CHOTA NAGPUR INCLUDING GANGPUR AND THE SANTAL PARGANAHS.

[A description of all the indigenous trees, shrubs and climbers, the principal economic herbs, and the most commonly cultivated trees and shrubs. With Introduction and Glossary. By H. H. Haines, F.C.H., F.L.S., I.F.S., F.R. Met. Soc., Conservator of Forests' late Imperial Forest Botanist, Forest Research *Institute. With* a Map Published by the Superintendent, Government Printing, India, Calcutta, 1910.]

This is a handy volume of 672 pages, measuring about six and a half inches long, five inches broad, one and three-fourth inches thick, and bound in dark-green cloth, its form offering a marked contrast to that of the somewhat ponderous first volume of the corresponding Forest Flora of the Presidency of Bombay. While absolute uniformity as regards Forest Floras is not necessary, it would be of practical advantage for Forest Officers who are continually moving from place to place if future Forest Floras could be arranged to follow a standard size, and for portability, size of page and clearness of type, this Forest Flora of Chota Nagpur might well be taken as a model. Although nominally a Forest Flora, the book is actually considerably wider in its scope, as it

includes references to the principal economic herbs, and the most commonly cultivated trees and shrubs.

The area, covering over 37,400 square miles, dealt with by Mr. Haines, includes in addition to the districts of Singbhum, Manbhum, Ranchi, Palamau, Hazaribagh and the state of Gangpur which constitute the civil division of Chota Nagpur, the district of the Santal Parganahs, which is politically part of the Bhagalpur division. The inclusion of the Santal Parganahs is justified by the topographical and botanical resemblance of that district to Chota Nagpur proper, while by its inclusion the Flora is made to cover all the Western Bengal forests, with the exception of those of Sambalpur, a district that only recently has been added to Bengal and the vegetation of which has still to a large extent to be investigated.

With the exception of a strip along the east and north of the Santal Parganahs that lies within the Gangetic plain, the area of the Flora is one of plateaux and hills varying from 400 to 3,000 feet in elevation. Mr. Haines gives a succinct account of the topographical and geological feature of each of the districts, incidentally referring to the Santal Parganahs as affording an instance of the evil effects of excessive deforestation. This is followed by an excellent and comprehensive description of the climate with tables of maximum, minimum and mean monthly and annual temperatures and of rainfall at various stations in the area.

The vegetation is essentially of the Monsoon forest type and more or less deciduous during the dry months, although the cool valleys and the tops of some of the highest hills exhibit a vegetation differing somewhat from the general type. The most characteristic tree of the area is *Shorea robusta*, Gaertn (the Sal), which however on the driest aspects gives place to such species as *Cleistanthus collinus*, Benth., *Anogeissus latifolia*, Wall., *Odina Wodier*, Roxb., *Nyctanthes Arbor-tristis*, Linn, and others of the "mixed forest" type. On the driest rocks purely xerophilous species occur, such as the fleshy *Euphorbias* and *Sarcostemma*. Most of the species avoid the evils of excessive transpiration during the dry seasons by declining to wear any leaves. Mr. Haines

mentions *Sterculia urens*, Roxb., *Odina Wodier*, Roxb., and *Cochlospermum Gossypium*, DC., as typical examples of trees leafless from November to May or June.

The area is characterised by the general association of *Shorea robusta*, Gaertn., species of *Anogeissus*, *Bassia latifolia*, Roxb., species of *Gardenia*, *Butea* and *Schleichera* and the grasses *Ischæmum angustifolium*, Hack. and *Heteropogon contortus*, Roem. The common sub-Himalayan associates of the Sal, such as *Dillenia pentagyna*. Roxb., *D. indica* L., *Careya arborea*, Roxb, *Stereospermum chelonoides* DC. and *Sterculia villosa*, Roxb., are scarce in the area, while Teak, *Dalbergia Sissoo*, Roxb., *Cupuliferæ* and *Coniferæ* are entirely absent in a wild state. *Rubiaceæ* especially of the genera *Gardenia* and *Wendlandia*, *Acanthaceæ*, species of *Bauhinia*, *Diospyros*, *Terminalia*, *Zizyphus*, and such species as *Cleistanthus collinus*, Benth., *Nyctanthes Arbor-tristis* L., *Ægle Marmelos*, Corr, and *Dendrocalamus strictus*, Nees, abound.

*Dillenia pentagyna*, Roxb., the common sub-Himalayan associate of the Sal is replaced in Chota Nagpur by *Dillenia aurea*, Sm. The *Anonaceæ* are fairly well represented, as also are the small families *Menispermaceæ*, *Capparidaceæ*, *Polygalaceæ*, *Combretaceæ* and *Lythraceæ*. On the other hand, *Urticaceæ*, *Magnoliaceæ*, *Ranunculaceæ*, *Cruciferæ*, *Guttiferæ*, *Ternstrœmiaceæ*, *Rosaceæ*, *Umbelliferæ* and *Lauraceæ* are poorly represented. The more important orders according to the number of species represented are *Gramineæ*, *Leguminosæ*, *Cyperaceæ*, *Orchidaceæ*, *Compositæ*, *Euphorbiaceæ*, *Acanthaceæ*, *Rubiaceæ*, *Scrophulariaceæ*, *Filicales*, *Labiatæ*, *Urticaceæ*, *Cucurbitaceæ*. Altogether about a thousand species are described or referred to.

Mr. Haines has grappled with the difficulties of classification in his own way, and has based his arrangement partly on the Genera Plantarum of Bentham and Hooker, partly on the German system as represented in Engler's Syllabus der Pflanzenfamilien. The cohorts of the Genera Plantarum appear as orders, while the natural orders of the same work appear as families, the latter change, however, being more apparent than real, as in the Flora of British India the expression "family" is an alter-

native to "natural order." The Monochlamydeæ of the Genera Plantarum are distributed amongst the Choripetalæ division of the Dicotyledons, so that, for instance, the *Lauraceæ* appear amongst the Ranales. Discussion of the details of the classification adopted by Mr. Haines is somewhat academic, but the allocation of some of the families exemplifies what room there is for difference of opinion as regards affinities. Out of the ten families allocated in the Flora to Parietales, four—*Papaveraceæ*, *Cruciferæ*, *Capparidaceæ*, and *Moringaceæ*—are by Engler ranked under Rhoedales and one, *Cucurbitaceæ*, under Cucurbitales. On the other hand, *Samydaceæ*, *Passifloraceæ*, *Papayaceæ* and *Cucurbitaceæ* appear in the Genera Plantarum as Passiflorales while *Tamaricaceæ* go to Caryophyllineæ and *Moringaceæ* remain as an anomalous family. In the Flora *Dilleniaceæ*, *Ternstrœmiaceæ*, *Guttiferæ* and *Dipterocarpaceæ* are ranked under Guttiferales. In the Genera Plantarum *Dilleniaceæ* appear under Ranales, and the other three under Guttiferales. In Engler's system all four are shown under Parietales. Of the five families *Anacardiaceæ*, *Sapindaceæ*, *Sabiaceae*, *Malpighiaceæ*, *Polygalaceæ* that in the Flora are Sapindales, only the first three appear as Sapindales in both the Genera Plantarum and in Engler's system. The last two appear as Geraniales in Engler as does the fourth in the Genera Plantarum, the fifth being shown under Polygalineæ in the latter work. *Celastraceæ*, *Rhamnaceæ* and *Ampelidaceæ* appear as Celastrales both in the Genera Plantarum and in the Flora, but *Rhamnaceæ* and *Ampelidaceæ* are ranked under Rhamnales by Engler. The Ranales of the Flora agree with both the Genera Plantarum and Englerian arrangements, except that as regards the Genera Plantarum *Dilleniaceæ* are transferred to Guttiferales in the Flora, while *Lauraceæ* are added to Ranales. Myrtales, Umbellales, Primulales, and Ebenales agree with the classification of both the Genera Plantarum and of the Syllabus der Pflanzenfamilien.

Of course, these differences or agreements have no practical effect on the actual use of the Flora, and while they indicate the troubles of the systematist, they also afford evidence of the thoroughness with which Mr. Haines has laid his foundation.

Doubtless the fact that the book is intended for use by those who start without a knowledge of systematic botany explains the giving in addition to the usual Latin names—English designations to the families, though it may be questioned if the English name tends to enlightenment in such instances as "The Desert Date Family" applied to the *Zygophyllaceæ* or "The Hiptage Family" applied to the *Malpighiaceæ*. An artificial key to the families and genera is furnished.

The Flora proper gives succinct descriptions of the families with in most cases keys to the genera and species. The specific descriptions are short, but combined with the keys should suffice for recognition in the field, and it is one of the excellent points of this Flora that it is written by one who knows his plants in their natural surroundings and has described them accordingly. The general specific description is followed by notes in smaller type, referring to habitat, times of flowering and fruiting, renewal of the leaves, and such like facts that are of great assistance to the field botanist in determining a species. The reviewer is interested to find that Mr. Haines' opinion coincides with his own as regards the venation of leaves and the character of the bark 'blaze' as aids to identification. The reviewer has used both characters largely in the course of examination of a good few thousands of specimens in the field during the last two years and can testify to the great help they may afford in checking the identification of fresh specimens. In an appendix Mr. Haines describes the blazes of a considerable number of trees, and in another appendix gives a glossary of the botanical terms employed in the Flora. There is a table for the conversion of Metric and English lengths, and there is a general index and an index of vernacular names. In the introduction there is also an interesting account of the vernacular names and the different races of the native population.

An excellent map on the scale of one inch to sixteen miles showing the district boundaries, the Government estates, private forests and protected and reserved forests in colours, fits into a pocket at the end of the volume.

There are a fair number of misprints, but one must not be too exacting when the difficulties of getting a technical work through the Press in India are taken into consideration.

Mr. Haines is to be congratulated on having added to the list of Indian Forest Floras, one of the most practical manuals that have yet appeared. It is a book which every one interested in the vegetation of Chota Nagpur should possess, and one that will be welcomed by Forest Officers stationed in that area who desire to increase their knowledge of their charge from the botanical side.

## THE "WATER-ELEPHANT" OF EQUATORIAL AFRICA.

For some time past rumours have been current as to the existence in Equatorial Africa of a large unknown mammal, which the natives call by a name equivalent to "water-elephant." Interest in scientific circles has been raised to a high point by the announcement recently made by Dr. E. Trouessart, in the Paris journal *La Nature* of 14th January, that the mysterious beast has actually been seen by a European explorer. Dr. Trouessart's account, as translated into English, is as follows:—"We have just obtained additional information with regard to the mysterious animal which inhabits the lakes of Central Africa, and which the natives call by this characteristic name on account of its aquatic habits. The following is what we have learnt from Mr. Le Petit, one of two explorers sent by the Paris Museum of Natural History to these regions, which are still so imperfectly known, more especially from the point of view of their fauna, as witness the history of the okapi. It was at Tomba-Mayi, on the northern shore of Lake Leopold II., that Mr. Le Petit saw these animals. That lake is situate on the left bank of the Upper Congo, in the district of Lukeni (Belgian Congo). The water-elephants, which formed a small herd of five head, halted at a distance of about 500 yards, in such a manner, that Mr. Le Petit was enabled to observe them for some seconds before they plunged into the lake. The trunk and the ears are remarkably short; the neck, on the other hand, is longer than in the elephant, and the height does

not exceed about 6 feet; there were no signs of tusks. The prints of their feet in the mud are very different from those of the elephant, and natives readily distinguish between the two. The animals, when they caught sight of the travellers, plunged into the water, and, leaving only the summits of their heads and their trunks exposed, swam towards the opposite shore. These details coming from a trained observer, are sufficiently precise to leave no doubt concerning the existence of the animal, whatever may be its zoological affinities."

When this translation appeared in the *Times* a reporter of the *Daily Express* called upon Dr. Chalmers Mitchell, Secretary of the Zoological Society, who attached considerable importance to the discovery.

"We have often heard reports of large mammals seen in Central Africa," he told the representative of that journal, "but now for the first time we have it on reliable authority. Dr. Trouessart is a serious and responsible person, the Chief of the Paris Museum of Natural History, and we may be sure that his representatives, on whose report the information is based, are also responsible men. It certainly appears likely that some hitherto unknown mammal has been discovered.

"The ignorance of travellers or natives often causes much confusion. These mammals are local in their habitation, and if one happens to be seen by a native a hundred miles from its natural home, he concludes that it is a new species. Rare skins have often been sent to us here, and proved to be merely those of some perfectly well-known animal that had strayed from its proper district.

"Water-elephant is an absurd term, for all elephants like water. It might possibly be a dwarf elephant. It could not be a rhinoceros or hippopotamus, but the description given does slightly suggest the tapir, which, however, are unknown save in America and the Malay Archipelago.

"We know from fossil history that there existed large numbers of smaller elephants; fossil remains, especially in the Fayum district of Egypt, have proved the existence of many kinds of

animals, all leading towards the elephant. It is conceivable that some elephant-like beast, more primitive than the elephant still survives."

This suggestion is supported by the circumstance that Mr. Le Petit's descriptions of the water-elephant would almost exactly fit the restoration of certain primitive elephant-like beasts from the Lower Tertiary strata of Egypt known as *Palæomastodon*. While some of these palæomastodons were not more than about 5 feet in height, others are estimated to have attained a stature of 6 feet, or the same as Mr. Le Petit's estimate of the height of the water-elephant. It is not, of course, meant by this to imply that the water-elephant is identical with the palæomastodon, which was one of the ancestors of the modern elephants, but it may turn out to be an allied type.

The next thing, of course, is to obtain an actual specimen of the beast, which, it may be hoped, the French explorers will succeed in doing. Till this is accomplished, further speculation is useless. [*The Indian Field.*]

## A WHITE-ANT RESISTING PAINT.

"EXTRACT FROM SCIENCE AND ARTS ARTICLE IN NOVEMBER 1908 ISSUE OF "CHAMBER'S JOURNAL," ON LOVELL'S "PALADIN" PAINT."

The task of thwarting the ravages of the white-ant in tropical countries is only too well known. It is for this purpose that iron is so extensively used in such climes; since, although more expensive both in first cost and maintenance, it is the only available material capable of resisting the voracious attacks of the termites. The great difficulty is that one cannot conceive that a structure is being destroyed by this insatiable pest until the whole fabric suddenly collapses, for the simple fact that the ants only work upon the interior of the wood, leaving the outer skin, which is about as thick as paper, absolutely untouched, so that to all intents and purposes the woodwork seems perfectly sound. This new composition is a paint, and is applied with a brush. It has been subjected to several trying tests, and certainly appears to justify the claims of its inventor. It has, moreover, anti-fouling and anti-corrosive

qualities, being fatal to all molluscs and vegetable organisms, while it also successfully resists the corrosive action of salt-water and atmospheric influences. Should it be equally proof against the onslaughts of the teredo, which in tropical and semi-tropical clime occasions so much anxiety, contractors and harbour engineers will indubitably welcome its introduction.

## THE PRESENT AND FUTURE OF TURPENTINE.

The stringent conditions which governed turpentine in increasing degree during 1910, and which culminated in American advancing from 40*s.* 6*d.* to 56*s.* per cwt., have been further accentuated by the addition of another 7*s.* 3*d.* in two months, making Wednesday's spot price 63*s.* 3*d.* The high level which now rules is really the summit, so far, of an upward move which began in the middle of 1909, when indications of a short crop established the market above 30*s.*, after about 12 months of low prices due to a plethora of supplies. The deficiency in the 1910-11 crop has been even more than that of 1909-10, and as a result consumers have to pay a figure unprecedented since 1905. The maximum and minimum prices from that year may be shown thus :—

| | 1905. | 1906. | 1907. | 1908. | 1909. | 1910. |
|---|---|---|---|---|---|---|
| Maximum ... | 63/6 | 50/3 | 52/3 | 40/3 | 43/3 | 56/0 |
| Minimum ... | 37/0 | 43/0 | 32/0 | 25/9 | 25/6 | 40/6 |

To this may be added the spot and arrival prices on Wednesday of each week of this year :—

| | Spot. | | Forward to April. | |
|---|---|---|---|---|
| | *s.* | *d.* | *s.* | *d.* |
| January 4th ... ... | 56 | 1½ | 56 | 6 |
| ,, 11th ... ... | 56 | 10½ | 57 | 6 |
| ,, 18th ... ... | 57 | 3 | 58 | 0 |
| ,, 25th ... ... | 57 | 6 | 58 | 0 |
| February 1st ... ... | 57 | 9 | 58 | 0 |
| ,, 8th ... ... | 60 | 0 | 60 | 6 |
| ,, 15th ... ... | 62 | 6 | 63 | 0 |
| ,, 22nd ... ... | 63 | 0 | 63 | 3 |
| March 1st ... ... | 63 | 3 | 63 | 7½ |

The production of turpentine is practically limited to three countries—the United States of America, Russia, and France—but

the latter two chiefly meet local requirements, and we are mainly dependent on the forests of Carolina, Georgia, and Florida, especially the latter, as the two first named are being exhausted. Last year we imported about 23,600 tons of turpentine in all, of which 18,200 came from the United States, but this represented a decline of more than 10 per cent. on the flush year of 1908; from France we took a fairly normal quantity of about 1,100 tons; whilst Russian imports at 3,700 tons showed an appreciable increase due to the larger use of substitutes. The American crop year runs from April 1st to March 31st, and the stocks and stuff afloat at the close of each of the last three years was :—

| | 1908. | 1909. | 1910. |
|---|---|---|---|
| Barrels | ... 51,749 ... | 34,214 ... | 26,103 |

The supply visible on December 31st last was the lowest since 1906, and in conjunction with the diminished rate of primary receipts made a statistical position averse to a decline in prices. High values will doubtless rule until the new crop conditions exert a determining influence one way or the other, and it may be noted that reports state that the weather has not been favourable for early production of the crop. Much has been made of the growing use of substitutes, and inasmuch as turpentine has, besides medicinal uses, industrial employment in the preparation of varnishes, as a diluent of pigments, as a cleansing agent, and in making rubber cements, etc., it can readily be appreciated that certain processes are amenable to substitution. Russian oil of turpentine, which is not so suitable for some of the above processes, is, by the way, said to be largely employed in the United Kingdom in the preparation of certain disinfectants. Figures show that Russian turpentine imports increase with diminished receipts from America and admitting that both Russian turpentine and turpentine substitutes are having a greater vogue that does not appear to hold out much hope of greatly affecting the price of the genuine article, which has been under the severer influence of their competition, and yet soars to a height almost unprecedented for years. Of course the records show that American turpentine is subject to considerable fluctuations, but when one considers the enormously

growing populations of the American Continent, with correspondingly increasing industrial demands, the outlook for an era of cheap prices is not very encouraging. What are wanted are newer fields of production, and thought naturally turns to India in this connection. There are large belts of pine forests, which, under private or Government development, could in time come to the world's rescue in turpentine supplies. Something already has been done in this direction. *Pinus longifolia*, which is plentiful along the Himalaya slopes, is the most important producer, and in North-West India, including Kashmir and the Native States it covers 2,000 to 4,000 square miles, its turpentine being more generally used than that of any other Himalaya conifer. *Pinus khasya*, on the hills of Burma, yields an oil which has been favourably reported on, and *Pinus Merkussi*, of the Shan States, offers opportunities for development. The present limited Indian production is all locally consumed. The first distillery was erected in 1888 at Dehra Dun, in the United Provinces, by the Imperial Forest School, but it was about 100 miles from the forest. It ran for 14 years at a profit, and later at a small loss. In 1895 distilling was started at Naini Tal, which is near the railway, and the Imperial Institute states that in 1900-01 the manufacture was a success, the prices obtained for the turpentine being equal to those on the imported article. In that year over 22,000 trees were tapped, 1,600 gallons of turpentine and 817 maunds (of 82·6 lbs. each) of rosin obtained. In the following year the success was even greater, 43,000 trees being tapped. A third factory was started in 1899 at Nanpur, in the Punjab, the annual supply of crude turpentine within easy reach being estimated at 10,000 maunds, capable of yielding 15,000 gallons of turpentine oil, and 7,500 maunds of rosin. Lately, evidence has been forthcoming that renewed attention was being given to the industry in the Punjab under the encouragement of the present high prices. We believe it will pay private enterprise to investigate the possibilities of the Indian pine forests, and in this they should, and we believe will, have every encouragement from the Indian Forest Service.—[*The British and Colonial Druggist.*]

## GUINEA-WORM.

DEPARTMENT OF AGRICULTURE, BOMBAY, LEAFLET NO. 6 OF 1910.

In many villages the people are much troubled by guinea-worm. This disease gives them much pain and prevents many cultivators from working in the fields for a part of each year. It can easily be avoided by people who will take a little trouble. The disease is caused by drinking water containing these worms in a very small state. The worms grow in the man's body and then try to come out through his legs.

The worms get into the water because people suffering from guinea-worm walk in the water and infect it with hundreds of very small worms.

To prevent the water of a well being infected by guinea-worm, all wells should be draw-wells and not step-wells; so that no one can ever stand in the water of the well. If the steps of all wells were closed up, guinea-worm would soon disappear.

The following rules should be observed :—

(1) Close up the steps on all wells where they exist.

(2) Do not drink water from a step-well if you can help it.

(3) If you must drink water from a step-well or from a tank boil it first; for this will kill any guinea-worms that may be in it.

(4) If a well is known to be infected, ask the nearest officer of the Agricultural Department to put some medicine (permanganate of potash) in the well which will kill the guinea-worms.

(5) If you are affected by guinea-worm, do not attempt to draw out the worm or wind it round a stick. This can do you no good, and may make it worse. Merely put a small piece of cotton cloth over the sore and tie it round the leg with a bandage, keeping the small bit of cloth quite wet all day. Every evening remove the small bit of cloth and apply a clean piece to the sore place, being careful to burn the old piece, since the discharge from the sore contains thousands of young living worms.

POONA:
*July* 1910.

# INDIAN FORESTER

*JUNE, 1911.*

## THE REORGANISATION OF THE PROVINCIAL FOREST SERVICE.

We have had many enquiries recently as to when the reorganisation of the Provincial Forest Service is to come into force, and as to the shape that it will take.

We are not yet in a position to give exact details, but we may say that it appears very probable that the scale of incremental pay as proposed some time ago will be generally given effect to, *i.e.*, that Extra Assistant Conservators will begin on Rs. 250 per mensem on their being appointed substantively to the controlling staff, and that they will rise by annual increments of Rs. 20 to Rs. 550 per mensem, after which promotion to the Extra Deputy Conservator grades will be by selection as vacancies occur in the cadres of the various provinces: that Extra Deputy Conservators will receive incremental pay of perhaps Rs. 25 per month until their pay reaches Rs. 650. Thereafter promotion to Rs. 700, Rs. 800 and Rs. 850 will be at the discretion of Local Governments as a reward for approved and meritorious service.

There is always the possibility of an Extra Assistant Conservator being placed, as a more or less temporary measure, owing to force of circumstances, in the charge of a Division of major control. In the event of this happening, it seems not unlikely that a personal or local allowance will be accorded in addition to salary—as a recognition of the increased responsibility entailed.

There are one or two other eventualities that will no doubt have to be met—thus an Extra Assistant Conservator drawing Rs. 550 per mensem may be in every way deserving of promotion to the Extra Deputy grades, but may be blocked by the non-occurrence of vacancies. Should this happen it would not be a matter of surprise to see that such a case has been specially provided for by a Local Government being empowered to give him a personal allowance after he has been a certain time on Rs. 550 a month, and even to increase the personal allowance in the event of a prolonged block in promotion.

The incremental pay will no doubt be drawn from the date of the appointment of an officer to the Provincial Service. Thus if an officer has been appointed in 1900, after 10 years we would expect to see him now drawing (Rs. $250+20 \times 10$) = Rs. 450. The case of appointments to the Service which in the first instance are temporary or officiating (but not probationary) will also doubtless be provided for, and we have reason for thinking that Local Governments will be given the power to allow such periods to count towards increment. This is as it should be, since it is only fair that if an officer undertakes the increased responsibilities entailed by an officiating or *sub. pro tem.* appointment to the controlling staff, this fact should be suitably recognised in his increments.

We have good reason to believe that the above *resumé* will be found to outline the new scheme when it appears, and we expect it to appear very shortly, and cannot but think that a scheme based on these provisions will be held to be satisfactory.

For one reason or another the scheme has been somewhat long delayed, and we trust that power will be given to Local Governments to bring it into force with retrospective effect from

the beginning of the current financial year. We have little doubt that this will be the case.

On the reorganisation being brought into force we hope to again allude to it in our pages when we have the full details before us.

A word of warning is here perhaps not out of place. In all schemes based on incremental pay Local Governments have full powers to defer increments in the event of an officer's work being not up to sample, the same is bound to be the case in the Forest Department; thus if an Officer thinks that he is as a matter of course to draw his increment whatever be the quality of his work, he may at times lay himself open to a disagreeable surprise for which he will have only himself to thank.

## SOME THOUGHTS ON DECENTRALISATION IN THE IMPERIAL FOREST SERVICE.

We note that this year for the first time, forest revenue and expenditure in the various provinces are to be wholly provincial, in other words, that they are to belong entirely to the province and not to be shared as in the past by the Government of India. This will undoubtedly benefit some provinces, such as Burma, more than others; we, however, foresee a wider issue. The decision of the Government of India not to participate in forest revenue and expenditure, if this arrangement is intended to be of a permanent character, which seems likely to be the case, appears to us a momentous one, and we doubt whether what we believe likely to be its far-reaching result has been grasped by the Department, or its full significance realised.

Once a province has been given full control over its forest finances, its next step will naturally be to demand, that in its own interests it should be at liberty to make what use it pleases of its staff without interference from outside and appoint as its administrative Forest Officers men from its own cadre, in whom it has confidence born of long acquaintance. This is a logical demand and in no way unreasonable, and the day is probably now not far

distant when we will see each province appointing its own Conservators and Chief Conservators, with the result that the Imperial Forest Department will become self-contained in each as is the case with the Civil Service, the Police, the Educational Department and possibly others. We do not say that this will happen to-morrow, as the full effect of this provincialisation, so to speak, of forest revenues, has to be first of all felt; moreover we doubt whether some provinces are as yet quite ready to break away entirely from the Government of India, that is to say, whether the state of their organisation will warrant their choosing their administrative officers from their own staff, or whether for the time being they would not prefer the appointment of such officers from outside. If this is so, we regard it as a temporary phase and have very little doubt that in the not very distant future the Forest Department in each province will be absolutely self-contained. This no doubt is one of the results of the Decentralisation Commission, accentuated by the disintegrating tendencies of the age. Already we see the hold of the Government of India over the Forest Department loosened in the greatly enlarged powers given to Local Governments and Administrative Officers, powers that would never have been dreamt of 25 years ago, and which at that time in the interests of the Public Service it would not have been expedient to give, and the grant of which was one of the chief factors necessitating the recent revision of the Code. The wisdom of granting these enlarged powers cannot be questioned and the result must have been foreseen, *i.e.*, that the central control over the working of the now Imperial, but what will shortly become Provincial Forests has been so relaxed that it is becoming little more than nominal. Up to somewhat lately no working-plan was brought into force until it has been rigidly scrutinised and critically examined at the head-quarters of the Government of India, now working-plans for the larger portion of the reserved forests are locally approved and may be in actual working before they are even seen at head-quarters: formerly the control forms of every working-plan were subject to a central check down to the smallest detail, now this check is relegated to the past. Looking to what has occurred it does not require a wide stretch of

imagination to foretell that eventually one procedure will be applied to all working-plans and that each province will be the exclusive authority for dealing with its own. This decision to decentralise working-plans we have no wish to discuss here, we need only say that while on the one hand it is approved, on the other strong views have been expressed, dissenting from what has been done, inasmuch as it is held that the working of forests in one province may have some bearing on the climatic conditions, the markets, possibly the agricultural welfare of another province, while there must be a tendency to a want of uniformity that may or may not be desirable. Nor is this tendency towards decentralisation in the various provinces confined to the Forest Department. It is extending to all Departments and its extension is being welcomed by them. It is perhaps the natural rebound that might have been expected from the ultra-centralisation of a few years back. In the Public Works Department, for example, we learn that provinces are appointing their own Superintending Engineers independent of the Government of India, each having, if we are correctly informed, a Superintending Engineer cadre of its own. If this independence of action has been acceded to in the case of the Irrigation Branch where the projects are often of Imperial interest and their execution carried out by means of Imperial funds, it stands to reason that in the case of the Forest Department, the arguments against more or less complete decentralisation must be difficult to sustain. Assuming then that in the course of it may be a few years, the Forest, as also other Departments will be self-contained in the various provinces and that the control of the Supreme Government will be so loosened as to be almost abandoned, the necessity of retaining the post of a Departmental head with the Government of India will doubtless be questioned in certain quarters. We make no excuse for alluding to this as a certain section of the public Press appears to be getting hold of the dangerous idea that because a service is decentralised, there is no work for, no scope for, and no need of, its having its representative with the Government of India. In this connection, and with reference to the

Forest Department, we read a few weeks back in the *Times of India* the following remarks :—

"In the first five years of the Department, the expenditure was nearly two-thirds of the revenue. It is still much above 50 per cent., although the revenue has increased from 67 lakhs to over 2½ crores. This is rather disappointing, and now that possible economies are being investigated, we may hope that the high forest expenditure will not escape scrutiny. One direction in which retrenchment can and ought to be immediately effected is the abolition of the office of the Inspector-General. His report is simply a summary of two-year-old information gleaned superficially from the provincial reports. We find nothing in it which even the Inspector-General is able to claim as being due to his advice or initiative, and we do not want a high-paid officer to summarise the provincial reports. Now that forests are a wholly provincial head, the office has no justification whatever, and its abolition would bring about a substantial saving."

The above extract displays an extraordinary ignorance of the duties of the Inspector-General. It stands to reason that the more Departments are decentralised and isolated from the control of the Government of India, the less the latter can know of their working; in other words, the Government of India is in danger of losing touch with the work going on in the Provinces. This being so there would appear to be the greater need of the presence of a senior administrative officer at head-quarters to explain the trend of Imperial forest policy to the various local administrations, and to maintain a close personal relation with the administrative heads of the Departments in the various centres, so that he may watch over the interests and aims of the Department as a whole and keep the Government of India informed as to the progress made. In other words, he is the medium through which the Government of India have to keep in touch with the workings of the Department. The fact that a Department is self-contained in each province is no reason for abolishing its direct representation at head-quarters; the reverse is the case, and if proof of this were needed, we have only to cite

the case of the Police and Educational Departments, which up to a few years ago had no direct representative with the Government of India. In each case, and we have no doubt that these are not the only two examples, high Imperial posts have had to be created to endeavour to ensure some degree of uniformity and bring the Imperial Government into closer touch with what was going on. In the case of the Forest Department the scope of the work of the Inspector-General may in some degree require to be modified; and it seems possible that instead of making prolonged tours in the forests themselves to see the results of Working Plans and the actual conditions of forest growth, (such work being left entirely with the local officers,) his presence may rather be demanded at the head-quarters of the Provinces in order to allow of his making the acquaintance of the heads of the administration and gaining a first-hand knowledge of the departmental aims of each Local Government, explaining at the same time the broad lines of policy of the Government of India. In the future this change appears perhaps not unlikely to be called for, and it will probably be on the right lines, as showing the intention of the Government of India to interfere as little as possible with local administrations, at the same time clearly intimating that they desire to be kept in touch with what is going on. What we wish particularly to emphasize is that the greater decentralisation that there is, the greater the need for a representative at the head-quarters of the Government of India.

Decentralisation we hold can be overdone. There is one power now exclusively in the hands of the Government of India that must be retained, and this is the power of disafforestment. It would never do to give Local Governments any opening to vary their forest policy, to disafforest lands at will, thereby nullifying the labours of years and frustrating the successful exertions of Forest Officers now dead and gone. Moreover, should any tendency towards disafforestation on the part of a ruler of a province be actually given effect to with the object of securing temporary advantages, it might well be that large interests outside the Province would become affected, while the surrender

of, or, in other words, the destruction of forests, as this is what it will come to, has long and justly been recognised in Europe as one of the prime causes of disastrous floods and in France alone has entailed the expenditure of enormous sums of public money.

A decentralised Department must suffer in one particular, and that is, in its prestige. In the case of the Forest Department we expect to see that in a few short years it will be split up into units incapable of cohesion or of concerted action in the various provinces, each of which will formulate its own Forest Code as is now done by the Madras. The title of " Imperial " will no doubt be maintained, it will be officered as now from England, but in every thing except in name, it will be Provincial, that is to say, self-contained in each province. Its prestige cannot but be affected. Its *esprit de corps* already seriously impaired by the abolition of Cooper's Hill and perhaps to receive a further blow, if this be possible, by the new recruitment rules recently circulated, will be given its *coup de grâce* by the difficulty, perhaps entire absence of cohesion.

In spite of this, given proper safeguards, we must confess that there is much to justify decentralisation to a greater extent than has now been carried out, and we are inclined to welcome the present tendency in the interests of progress.

One point strikes us somewhat forcibly. Any demand for largely increased expenditure on the part of a Local Government, to meet, we will say, additional establishment deemed by it necessary, will, in the first instance, be most carefully considered and examined on the spot possibly to a greater degree than at present; once this stage has been passed, the Government of India will have little ground for refusing to sanction such expenditure as it will fall entirely on the province; this, we think, will be an advantage, allowing of more rapid progress.

When once the last stage has been reached and the Department becomes self-contained and its total strength fixed for each province, then the India list of Conservators will go, and each province will have to formulate proposals for the pay and emoluments

of its Conservator or Conservators as it may deem desirable. When this happens we trust that the emoluments fixed in each case will be commensurate with the importance of the post, though the past history of the Department prevents us from being unduly optimistic.

## FORESTRY COURT—ALLAHABAD EXHIBITION.

In our March-April number we published an account of the Forestry Court, Allahabad Exhibition. Another article dealing with the same subject has been sent us by Mr. D. O. Witt, Deputy Conservator of Forests. As the subject possesses a somewhat unique interest to many of our readers we give *verbatim* Mr. Witt's article below.

" To those readers of the *Indian Forester* who did not have the privilege of visiting the United Provinces Exhibition and of seeing for themselves what was undoubtedly one of the gems of that Exhibition, *viz.*, the Forestry Court, the following account will, it is hoped, prove both instructive and interesting. Constituting but a part of a well-devised scheme for the complete representation of the industries and trade of the country, the Forestry Court received due recognition of its importance from the United Provinces Government and three spacious buildings were allotted for the display of the products of the Government Forests and all that concerns their manifold working.

The bringing together of the very representative collection which was finally housed in these three buildings was entrusted to the Forest Department, under the able direction of Mr. P. H. Clutterbuck, Deputy Conservator of Forests, who was assisted in his task by Mr. V. A. Herbert, Assistant Conservator of Forests. How successfully their work was accomplished the detailed account that follows will, it is hoped, show. The assistance given by Forest Officers all over India in collecting and forwarding interesting exhibits largely contributed to the success of the whole. In the main, however, it must be said that the products of the United Provinces forests predominated.

It will not be out of place to say a few words first regarding the buildings in which the exhibits were housed and the general scheme of arrangement. The Forestry Court occupied about six acres in the south-west corner of the Exhibition grounds. There were three fine buildings, in the Indian style of architecture, an eastern, central and western overlooking the Jumna river, with a fine stretch of lawns in front of them and fountain in the centre. Behind these were some smaller buildings for the display of numerous forest industries in the working, also a shed devoted to machinery and alongside certain forms of mechanical transport.

EASTERN BUILDING.

We will commence with the eastern building which was chiefly devoted to the display of the principal timbers of the United Provinces together with specimens of other important timbers which might prove useful in developing industries. Five foot lengths of each species were exhibited with the bark on, and with a longitudinal section cut in front showing the colour of heart and sapwood both plain and polished. The labels for these logs had been prepared from wood of the species concerned. Squares of the more important species were displayed and hand specimens of all species. In addition botanical specimens of the principal trees were shown framed in the wood of the tree in question.

These timbers were arranged down both sides of the building and down the centre on either side of a large central screen 60 feet long.

The most noticeable feature of this exhibit was the very large size of the specimens exhibited.

Some magnificient logs of sal (*Shorea robusta*), the most important species in the forests of the United Provinces, were exhibited from the Kheri forest and some splendid beams, the largest 44′ × 13″ × 13″, from the Garhwal Division.

Very fine was a 5 feet length of *Cedrus Libani* with a girth of 18 feet, as also a similar length of *Picea Morinda* with a girth of 17 feet, both from the Jaunsar Division. A fine length of Sáj (*Terminalia tomentosa*) with a girth of 9 feet was noticed, while the

western bay of the court had a panelling the framework of which was Sáj indicating in a striking manner the possibilities of this wood for internal work. Samples of sandalwood from Mysore and a fine baulk of Padauk (*Pterocarpus dalbergioides*) from the Andamans were other noticeable exhibits.

The uses to which ornamental woods may be put was clearly demonstrated by some fine carved ebony screens from Nagina, similar screens and tables of carved Sissoo from Jullundur, Sissoo inlet with ivory, and a collection of teak carvings from Burma, including a fine gong-stand.

The eastern bay of the building was panelled with Sissoo showing off this beautiful wood to great effect, in the upper panels of which were displayed a collection of paintings of the flowers and leaves of forest trees and plants from the Central Provinces by Mrs. D. O. Witt.

Similarly in the western wing was a series of fine photographs of forest scenes enlarged by Messrs. Lawrie & Co. from negatives by Mr. R. C. Milward, I.F.S.

An interesting exhibit was a large assortment of camp furniture by Messrs. Luscombe & Co. of Allahabad, tastefully arranged in one of the bays, while the two recesses at the north end of the building were completely furnished by Messrs. Md. Yakub and Sons of Bareilly, and in them was to be found as complete a collection of literature on forest and sporting subjects, chiefly written by Forest Officers, as one could wish to see.

Mention has been made of a large central screen 60 feet long running the length of the building. Both sides of this screen were covered with a fine collection of artistically arranged skins of tiger, panther, and other animals, the principal being three splendid tiger skins exhibited by His Honour Sir J. Hewett, K.C.S.I., three tiger skins and a large panther skin by Lady Hewett, and a beautiful specimen of the clouded Leopard exhibited by Mr. P. H. Clutterbuck.

Finally the general scheme of decoration of the building was completed by a display of sporting trophies on the walls at both ends and in the various bays. The measurement of each head was

given, and added greatly to the interest of this collection and testified to the general excellence of the trophies exhibited. Amongst so many fine heads the difficulty of selecting any for special mention is great, but three buffalo heads shown by Mr. C. R. Cleveland and the collection of swamp and spotted dear heads by Mr. J. C. Faunthorpe as well as the collection belonging to Mr. W. B. Cotton were all admirable.

CENTRAL BUILDING.

The central building, a smaller one than the eastern and western, was entirely devoted to sport. At one end Messrs. Lyon and Lyon of Calcutta, had a fine display of guns and rifles by the best makers, with a representative in attendance ready to assist intending purchasers and take orders.

The gentle art of fishing received due attention from Messrs. Hardy Bros. of Alnwick, and Messrs. T. P. Luscombe & Co. of Allahabad, the exhibits of fishing rods and tackle by Messrs. Hardy Bros. being particularly good.

Here also were to be seen a number of collections exhibited by well known taxidermists. Some of the work was distinctly good. The firms exhibiting specimens of their work were Messrs. Murray Bros. of Bombay, Theobald Bros. of Mysore, Van Ingen and Van Ingen of Mysore, Peter Spicer and Sons, Leamington, England, and the Bureau of Scientific Taxidermy, Dehra Dun. A bison head by Messrs. Theobald Bros. was particularly natural and life-like, and very beautiful was the skin and head of a snow leopard by Messrs. Van Ingen and Van Ingen.

The uses to which crocodile skins can be put was admirably illustrated by a large selection of bags, dressing cases, etc., by the N.-W. Tannery Co., while a complete gharial skin tanned was shown by Messrs. Shewan & Co. of Cawnpore.

In the central portion of the building the most prominent feature was a large jungle scene arranged by Messrs. Murray Bros. of Bombay. The scene included a tiger charging out of the grass in one corner, a panther stalking a spotted deer, and several smaller animals, while numerous small birds were seen

perched on the branches of the trees. The whole arrangement was most realistic and a credit to the firm that devised it.

On the walls of the building was on view as fine a collection of heads as one could wish to see. Outstripping all others in size and massive grandeur, the most noticeable head was the world's record sambhar, a magnificient trophy 50½ inches in length, and well proportioned, exhibited by H. H. Colonel Nawabzada Obaidulla Khan of Bhopal. Another very fine sambhar head was that shot by Mr. Thompson of Lucknow, with an exceptionally wide spread, whilst a third shot by Mr. Nethersole was of the nature of a freak, being very thick at the base, no less than 11½ inches, and branching upward into a number of tines. Here also were to be seen two record heads of gond or swamp deer, one of 41 inches, shot by *Mr. B. P. Standen*, being the record for the whole of India, and the other of 40⅛ inches exhibited by the Hon Mr. J. A. Broun being the largest ever shot in the United Provinces. Another interesting swamp deer head, exhibited by H. H. Sir J. Hewett, had no less than 26 points.

Some excellent cheetal heads were on view, several fine black buck including one of 27⅝ inches exhibited by Mr. Cavallo, and a chinkara head of 14¼ inches belonging to Mr. L. McDowell. A fully set up Indian rhinoceros head, a very large Indian elephant tusk, measuring 7'-9," buffalo and bison heads, Kashmir stag, hog-deer, markhor, ibex, urial, musk-deer were but items in a collection of trophies which only required to be seen to be appreciated and which it would be difficult to beat anywhere.

Curiosities were not wanting, in the shape of a buffalo calf with two heads, a black buck of a uniform black colour throughout, *and a doe with the colouring of a buck* and curious twisted horns.

WESTERN BUILDING.

The western building was devoted mainly to the display of minor forest products.

On entering was to be seen on the left a well arranged exhibit by Messrs. Ahmutty & Co., Calcutta, consisting of a variety of ropes of all sizes from the thickest cable to thin twine, made from

hemp, coir and aloe fibre. Of still greater interest as showing what fibres can be utilised in rope-making was an exhibit by the Ganges Rope Co., which included rope and twine from about 1 inch diameter downwards, made from *Grewia oppositifolia*, *Sida carpinifolia* *Kydia calycina*, *Sterculia villosa*, *Thespesia Lampas*, *Bauhinia Vahlii* and others. The fibres also were to be seen in each case.

Next to the rope exhibit of Messrs. Ahmutty & Co. was an exhibit of Solignum, the latest preserver against the ravages of white-ants. Three pegs were to be seen, one of which had been treated with Solignum, while the others had not. They were then buried in the ground. The two not treated with the paint were absolutely riddled by white-ants after three months. That treated, after being buried 13 months, was in the same condition as when first buried. All woodwork in the Forestry Court was treated with Solignum and Mr. Clutterbuck informed me that since this was done attacks from white-ants which had previously been very severe had entirely ceased.

Near by was a most interesting exhibit of a series of timber specimens showing the various kinds of damage done to them by animals, especially deer, bear and porcupine, insect parasites and climbers. Along the same side a representative collection of forest implements was shown consisting of every form of axe, adze, sickle, bill-hook, saw, file, etc., used in the exploitation of forest produce.

At the far end of the building the Indian Museum, Calcutta, had a large exhibit, consisting of several show cases containing specimens of the more valuable fresh-water fish suitable for stocking tanks and rivers; other cases contained specimens of Indian centipedes, scorpions, snakes, rats and insects.

Specially instructive were the examples of harmless snakes side by side with poisonous snakes for which they are frequently mistaken.

Insects were represented by those which are most objectionable to man, such as flies, bugs and mosquitoes. The life-history of an anopheline mosquito which spreads malaria was fully illustrated.

A large number of small wood industries were represented. Of primary importance might be considered the exhibit of different kinds of matches with specimens of the woods from which they were made by the Amrit Match Factory in the Central Provinces and an exhibit of match splints by the well known firm of A. Roller & Co., Berlin.

There must be a great opening in this country for any enterprising firm well equipped with modern match-making machinery. Other exhibits consisted of various kinds of brushes made from United Provinces timbers by the Indian Brush Factory, Cawnpore; pencils, illustrating the process of manufacture by the Small Industries Development Co., Limited, of Calcutta; and a large collection of wooden utensils, toys and agricultural implements.

While on the subject of woods mention should be made of the exhibit of specimens of timber treated by the Powell Wood Process. This process consists in injecting into the cells of the timber a preservative liquid, which not only preserves the timber against rot but greatly improves the quality of inferior timbers and brings them into first class rank.

Arranged on shelves down the centre of the room were collections of minor forest produce, including many interesting samples of tanning materials in the raw, and manufactured into tanning solutions together with hides and calf and goat-skins tanned with these products; a series of gums; oils, the products of the destructive distillation of various woods and grasses; samples of honey and wax; drugs for all ailments, and a large collection of edible forest products. An examination of this last collection made one realise what a boon the Government forests must be to the people in times of famine.

Some interesting exhibits of lac both in the natural and manufactured state were to be seen.

The best of these was an exhibit of floss lac in appearance like raw spun silk. It is said not to block under heat or pressure, dissolves more easily in spirits of wine, and is cheaper to manufacture than shellac.

In addition to all these minor forest products there was much to interest one in this building. The large bay on the western side was devoted to a fine jungle scene arranged by Messrs. Murray Bros. of Bombay in which were displayed three fully set up tigers, while the eastern bay was panelled with a framework of Tun (*Cedrela toona*) into which were set panels of different kinds of ornamental woods and above these were some fine enlarged photographs of forest scenes and operations. Elsewhere throughout the building were displayed numerous photographs, mostly enlargements, illustrating the different sylvicultural systems under which forests are managed, methods of transport, forest scenes, etc.

The decoration of the principal walls was materially helped by a display of heads consisting of buffalo, spotted deer, sambhar, swamp deer, Kashmir stag, ibex, etc., while down the centre of the building ran two screens each 30 feet long covered with skins of all sorts.

This concludes the review of the contents of the three main buildings. We have still left the smaller buildings and sheds in which were to be seen a number of interesting forest industries in the working.

For instance, there was a complete turpentine distillery at work separating the resin of the Chir Pine (*Pinus longifolia*) into turpentine and rosin, as carried out at the turpentine distillery at Bhowali in the Naini Tal Division.

The extraction of Katha from Khair (*Acacia Catechu*) was being carried on in another shed and there was a lac factory exhibited by H. H. the Maharaja of Rewah, showing the manufacture of shellac from the crude stick lac.

Perhaps the most interesting and important of all was a Paper Pulp Laboratory fitted up with the necessary apparatus for testing the values of different kinds of woods and grasses as pulp producers.

Here the practical work of testing woods was being carried out by Mr. Raitt, an expert in all that concerns the paper industry. At present Sabai grass pulp is the main source of the paper pulp used in the Calcutta paper mills. There is no doubt that the substitution of a good and cheap wood pulp for the present

inadequate supplies of grass pulp would be the saving of the paper industry in India.

Mention has still to be made of the wood working machinery which could be seen at work. It included some of the latest types of sawing, planing and moulding machines.

Mechanical forms of transport were illustrated by a small 2 feet gauge railway, exhibited by the Decauville Company of Calcutta. It included a 20 H. P. locomotive and trucks suitable for the carriage either of logs of timber or material, such as earth, sand, etc. A more convenient or practical type of light railway for forest work it would be difficult to imagine. A very different type of transport was exhibited by Ropeways Ltd. of London, consisting of a continuous wire ropeway actuated by a small stationary engine, and carrying on it travelling cradles. There should be great openings for this form of transport in this country when it is better known."

## AN ELEPHANT CAPTURE IN SOUTH MALABAR.

Having received information from the Range Officer that a young elephant had fallen into one of the Government elephant pits some 12 miles from head-quarters, the Collector, who was staying with me at Nilambur, and I made arrangements to go out and superintend the capture.

On the following morning we set out before daylight and arrived at the pit to find the preliminary arrangements for taking out the captured elephant in full swing. Trees had been felled and dragged over the pit, billets and branches for throwing into the pit to raise the level were being cut and heaped beside the pit, water to pour on the elephant was being brought in bamboo tubes, and fodder had been stacked on the edge of the pit. The elephant Mahouts and other junglemen, mostly Naickens and Panniars, were busy making ropes out of the *Sterculia* fibre which is always kept ready in stock at the head-quarters of the Range. Ropes are always made at the pit and are not kept ready made and after they are used they are untwisted and the fibre is stored for future use. Three separate thongs are prepared which are then twisted into one rope which is almost as thick as a man's wrist. On this occasion two such ropes were required, one for the neck and one for a hind leg.

Having prepared the ropes the neck noose has to be made. The circumference of an elephant's neck being approximately ⅛ less than its height which is measured by letting a bamboo down into the pit, the necessary length is measured off on the rope and a dumbbell-shaped piece of wood about 9 inches long is put through the twists of the rope and fastened securely to prevent the noose tightening beyond that point and so strangling the elephant. The noose is then formed by drawing the end of the rope through a loop at the noose end.

Three or four strings are now fastened at intervals round the noose so that several people may be able to hold it in position. Everything now being ready, the far end of the rope is fastened to a tree and a number of coolies hold it and are ready to pull the noose tight when the word is given. The men with the noose

stand on the logs which have been tied across the pit, and the noose, which has been opened so that its diameter is about 3 feet, is dangled over the mouth of the pit. Fodder, preferably bits of succulent plantain stem, are then offered to the elephant, and as soon as it puts up its trunk to take the fodder, down drops the noose and the coolies pull it tight. Curiously enough a wild elephant even when in the pit will eat readily and will take fodder held over it from the hand.

Having got the noose over the elephant's neck it has to be fastened securely to prevent it slipping back or being pulled back by the elephant's trunk. This tying of the noose is really the only part of the work which is dangerous, and even this does not involve much risk if the men who do it are used to the work. Two or three men lie or sit on the logs over the pit, and whilst the neck rope is held tight by the coolies, they bind cords tightly round the wooden stop and the end of the noose to prevent the latter from slipping.

Next comes the noosing of a hind leg. No wooden stop is required in this case and the noose is simply let down by strings to the bottom of the pit and held against the elephant's leg till he puts his foot into it when it is drawn up tight. This noose has also to be tied with cord to prevent it slipping. This is done by using bamboo with a hook at the end and, as can be imagined, it is rather a slow and difficult operation, tying knots with a hooked bamboo 12 feet long instead of with one's fingers. After both ropes are fastened securely, billets and branches are thrown into the pit to raise the level.

In this instance, whilst this was going on "Jupiter" and "Maharajan," the two tuskers who were to march off the captured elephant, were brought to the edge of the pit to have a look at their captive. As soon as sufficient billets had been thrown in, the neck rope was unfastened from the tree and wrapped about four times round "Jupiter's" body and fastened. The leg rope was then fastened round "Maharajan" in a similar manner, more billets were thrown in and the logs were removed from the top of the pit. After one or two scrambles the elephant got out. As a rule on

finding itself out of the pit an elephant makes one or two bids for freedom, but in this case the capture gave no trouble at all and the 4 mile march to the kraal was started at once. Four or five other elephants as well as "Jupiter" and "Maharajan" had been brought to the pit to help to drag logs and also to gain experience in capturing operations. They now closed round the other elephants and all marched off together, the new capture in the middle.

On arrival at the kraal the neck rope was unwound from "Jupiter" and passed through the opening of the kraal and fastened to a pillar on the far side. The capture was then pushed in from behind by the tuskers and the bars of the kraal were driven home.

All along it had been thought that our capture was a female elephant, but now after we had spent much thought on finding a suitable name it was discovered that it was a "muckna" or tusk-less male and the search for a name had to begin again. It was gently hinted that one of our other elephants had been named after a former District Forest Officer, but as I had no reason to think myself a "muckna" I did not accept the hint.

There is a very interesting old custom in connection with elephant capturing in South Malabar which is worth mentioning. Each track of jungle has its hereditary lord of the soil or Jenmikar as he is called. These men who are wild junglemen have no legal rights whatever over the forest or the elephants, but on the occasion of each elephant capture the following ceremony has to be gone through :—

As soon as the neck noose is prepared the Jenmikar is presented by the Forest officials with a small sum of money, a cloth, a bottle of arrack, rice, cocoanuts, areca-nuts and tobacco. He then does homage and says a short prayer presumably to the deity who presides over the wild elephants of the locality and then solemnly hands over the noose to the Forest officials.

Usually whilst the noosing is in progress the Jenmikar and a few select friends retire behind the nearest bamboo clump, and by the time the elephant is taken out of the pit the arrack bottle is empty and the Jenmikar and his friends are in high spirits

and are only too anxious to help Government to capture more elephants.

In addition to the present to the Jenmikar the Forest Guards and other Forest subordinates receive rewards of money varying in amount according to the size of the elephant captured and the difficulty experienced in taking it out of the pit.

I may mention that "Aga Khan" has now been in captivity for seven weeks. For some weeks past he has allowed his Mahout to go in to the kraal with him and handle him and wash him. He can also carry out the more simple words of command such as salaaming, bending, and raising his foot and he will also allow his Mahout to sit on him.

CAMP OOTACAMUND:
*20th April* 1911.

A. WIMBUSH,
*Assistant Conservator of Forests.*

## GENERAL PRINCIPLES OF FORESTRY.

A LECTURE DELIVERED BY R. E. MARSDEN, I.F.S., AT THE SCHOOL OF ECONOMICS, LONDON UNIVERSITY, JANUARY 1910.

GENTLEMEN,—There are many purposes for which forests are maintained such as to yield a particular product—oak for the Navy—or to produce the greatest possible volume of wood per acre and year, or to produce indirect results like fixing shifting sands, influencing the climate and rainfall, preventing erosion, maintaining water-supply in catchment areas for water-works, or to produce shelter under which grass can grow instead of being scorched to death as in India, and so on; but the forestry about which I propose to speak to-night is the economic utilisation of the productive capacity of the soil by means of timber-crops. And by using that word "economic," I imply that this utilisation is to be carried out without waste and without any weakening of the productive powers of the soil.

First of all, I want you if possible to avoid looking upon a forest as a collection of individual trees, but rather to consider the forest as a whole—as an area of land under a timber-crop, the area of the forest being expressed in acres and the success of the crop being

gauged by the production of timber per acre regardless of how many trees there may be. We deal with sylviculture, the wholesale business of producing timber, and not with arboriculture, the retail business of growing specimen trees. When considering a crop of corn one does not pick out a particular ear and remark on the beauty and symmetry of that ear; one considers the number of bushels produced per acre; in just the same way for forestry the best way to estimate the success of a crop is to examine the volume of timber produced per acre. Economic forestry means the production of the largest possible crop per acre of the best possible quality without exhausting the soil. If one system of management produces a crop yielding 10,000 cubic feet per acre while by growing in another way the outturn is only 6,000 cubic feet, the species, age and quality of produce being the same, the former method is the better. It is not the tree that is to be developed, but the fertility of the soil that is to be exploited. In the slide on the screen you will see what I mean. Here is a crop of beech 157 years old yielding about 5,000 cubic feet per acre. By thinning this wood heavily, finer individual trees would be produced but fewer and the total production per acre would be very much less. The next slide shows the result of disregarding this consideration. I should like you to compare these two woods carefully. I started by saying that the productive powers of the soil must not be impaired, but it is necessary to lay more stress on this, the first fundamental principle of forestry. The fertility of the soil is one's capital, and injudicious management impairs its capacity for yielding interest or returns in timber. A forest is a large body of trees depending upon each other for support against adverse climatic conditions, existing and growing as one community.

Growing a crop in the open way shown on the screen lays bare the soil to scorching by the sun, to the violence of the wind which blows away all dead leaves or in India dries everything up, and to the eroding effect of rain beating down upon the unprotected ground. The result of this carelessness is to discount the future productivity of the land and to decrease its capital value. Not only is the soil damaged, but the crop itself suffers in

diminished height-growth, in liability to be thrown by wind, and in inferior quality as well as in smaller quantity of timber produced. By growing woods in "normal density" as it is called, not only is such damage avoided, but other benefits are obtained. Normal density implies an uninterrupted leaf-canopy. The soil is sheltered by this canopy and the leaf-fall manures the ground. Moreover, the stems are drawn up into straight clean poles, the effect of the absence of light inside the forest being to kill off all side-branches when they are quite small, thus preventing the formation of knots of any size, a knot in timber being nothing more than the axis of a side-branch.

Another perhaps more obscure but not less important result of keeping crops thick is the increase in the cylindrical shape of the stem as opposed to the conical shape. This comes from the foliage being confined to the top. The foliage has for its chief function the assimilation of carbon from the carbon dioxide present in the air, and the tendency is for the carbohydrates formed by the chlorophyll of the leaves with the aid of the sun's light to be laid on the stem in the neighbourhood of the foliage. Increment begins at the top and is gradually continued toward the base, so that by doing away with the lower branches, either as a result of growing the trees close or by pruning, the tree is made more full-bodied and approaches more closely to the cylindrical.

If a wood is too open, vegetative energy is dissipated in branch-formation instead of being utilised to form a long straight stem while the soil suffers from exposure to the elements, and the timber in the case of fir trees becomes coarse and sappy with wide rings and open grain leading to early decay and a decrease in strength; if a wood is too crowded the individual stems cannot obtain the necessary light, air, and warmth, and become lanky weaklings, liable to fall over with the first snowfall or to die of starvation—in any case forming a *point d'appui* for an attack of injurious insects or fungi upon the crop. The maintenance of a normal density by allowing to each stem sufficient space for the healthy action of a moderate-sized crown in assimilating carbon from the carbon dioxide of the air for the formation of wood, but not

so much space as to encourage the crown at the expense of the stem or to prolong the life of the lower branches, is thus indispensable for the formation of valuable timber. Not less indispensable to the continued activity of the soil is the maintenance of an uninterrupted leaf-canopy. When green, leaves shelter the soil from extremes of sun's heat and violence of wind and rain; and when dead, they fall and decay forming humus or leaf-mould whose value to any soil is well known. Perhaps the chief value of humus is its power of improving the porosity of the soil. In agriculture or horticulture ploughing is permissible to break up the soil and render it porous, and manuring may be done. But in forestry the cultivation of the soil is on too large a scale for such operations to be practicable. One has to rely on humus and on the beneficial effect of a dense leaf-canopy. Leaf-mould makes a clay soil more friable and a sandy soil more binding; it absorbs and retains moisture instead of allowing it to drain off into the nearest water-course; it retards evaporation, adds depth to the soil, and facilitates decomposition of organic matter by allowing the air with its oxygen to penetrate into interstices.

Of the mineral matter consumed by trees out of the soil, 87 per cent goes to the leaves and only 13 per cent to the wood, so the importance of not allowing leaf-litter and humus to be taken away from a forest needs no further insistence. By taking it away the forests of Nurenberg, once capable of growing fine oak timber, can now barely raise a crop of miserable Scots pine, the tree which contents itself with least mineral food of any, it takes about one-fourth of what oak and beech demand in the way of mineral nutriment.

It may be asked why we have not been accustomed to this system of dense crops in Britain, and the answer to this is that the growth of oak for our Navy has obsessed us to such an extent that we have based all our methods of forestry on the system adopted, and quite rightly too, for growing crooks and knees for our ships. In 1831 Patrick Matthew gives detailed directions how to produce bent and misshaped beams; this is possible only by giving each tree a large growing space and by disregarding height-growth

entirely, something as in the picture of open beech forest you have just seen. Hence our inherited prejudice in favour of open woods. The introduction of larch, which almost alone of European species produces good timber in open woods, and the subsequent successful afforestation of 15,000 acres by the Duke of Atholl with this species between 1774 and 1829 helped to spread this principle, which was finally recognised in the first standard work on British forestry by Brown of Arniston in 1850, when the usual scale was to allow each tree to stand one-third of its height from its nearest neighbour. This scale was also recognised in the estimate laid down in 1851 that it took the produce of 44 acres of oak forest to make a 74-gun ship, or 2,200 trees : this shows that the stock of mature trees per acre was 50, which would thus stand 30 feet apart. Since then game-preservation with its dependent necessity of maintaining undergrowth (which cannot exist in pure high forest of normal density) has prevented any general change from the old ideas.

The motive underlying the recognition of forestry by the State in this country has hitherto been the need of supplying timber for building the ships of the Royal Navy. The early records abound in orders for preserving trees as cover for game, but 1482 in the time of Edward IV seems the first date any attention was paid to maintaining the regeneration of a forest by excluding cattle. Henry VIII in 1543 in the Statute of Woods laid down that when clearing a wood 12 standards per acre must be left for the purpose of providing seed, and Elizabeth reinforced his orders finding the smelting of iron in South-East England had led to destruction of the forests. In 1615 appears the first treatise on afforestation, by Arthur Standish, in which he draws attention to the vast area of waste land, estimated at 25 million acres, which could be planted up, and in 1662 John Evelyn read his essay before the Royal Society as a result of the Commissioners of the Navy having asked the Royal Society to suggest a remedy for the scarcity of oak for the Navy.

In 1668 an Act was passed to enclose and plant up 11,000 acres of the Forest of Dean, and in 1698 there was a similar Act for

planting up the New Forest. However the stock of timber continued to diminish, and in 1805 the East India Company were asked to what extent a permanent supply of teak might be expected from Malabar. This led to the appointment of Captain Watson in 1806 to administer the forests of Southern India, and later in 1842 to the plantation of teak at Nilambur being started by Mr. Conolly, Collector of Malabar. Subsequently in 1864 it was found necessary to establish a special department to regulate the management of the Indian forests. But it seems likely that India owes the preservation of her forests primarily to the need of providing suitable timber for the British Navy, just as the big timber in the Forest of Dean and the New Forest was originally planted for the same purpose.

It is not every kind of tree which can maintain a dense canopy over the soil and protect it properly, and in nature while some species like beech, silver fir, and spruce are found covering vast tracts forming pure unmixed woods, as, for instance, the beech in France and Central Germany, the silver fir in the Vosges, the Jura, and the Black Forest, and the spruce in Scandinavia, other species such as ash, elm, sycamore, sweet chestnut, and maple are never found naturally in pure woods, they attain perfection only if mixed. The power of preserving unimpared the fertility of the soil governs the adaptability of any species to be raised in pure woods. As a general rule it may be safely asserted that mixed woods are preferable to pure woods, the single advantage of the latter being that they do not call for so much skill on the part of the forester in charge. Whereas mixed woods not only avoid the risk of damaging the fertility of the soil, but they have the supreme advantage of being less exposed to damage by insects, fungi, snow, wind, fire, etc., while at the same time producing larger and finer timber. That our woods in Britain have suffered so little in comparison with Continental forests from insect and fungus attack is to a large extent due to the strong prejudice here in favour of a mixed plantation. The damage done by the Nun moth in 1853—1862 in East Prussia and West Russia extended over 7,000 square miles of conifers and caused the premature fall of

8 million tons of timber, while woods with a mixture of beech scarcely suffered at all. Mixtures need not be even-aged, and need not be casually mixed by individual trees, though such even-aged mixtures are preferable to pure forests over vast tracts. If the forest is to be even-aged, the mixture is best by groups not exceeding 500 acres each nor less than 20 acres. If the forest need not be even-aged, under-planting should be practised. This practice of under-planting is one deserving of more experiment and of a wider appreciation by landowners. It is the method par excellence for producing timber of large dimensions and exceptional durability.

In Britain with our mild climate and damp air we suffer from a far more luxuriant growth of weeds than the Continent, and *this practically limits our choice of the way to start a crop.* We have to plant and not to sow ; the latter is cheaper, and for some species like oak and Scots pine produces better trees, but with weeds springing up and choking the seedlings as soon as the seeds germinate, we have had to adopt the system of raising our seedlings in a nursery and then transplanting them into the forest when they are of a size sufficient to withstand the weed danger. This method of raising trees in a nursery is first mentioned by Standish in 1615.

Plantations have several advantages compared with crops raised from seed ; each individual plant has a fixed area of growing space and the process of natural selection proceeds so much more rapidly that there is less risk of overcrowding, while at the same time the volume of timber produced per acre is certainly not less than with sown crops, which are always denser and so have smaller stems. *In dense sown crops there is always an immense proportion* of suppressed and dominated trees—in a plantation the vegetative energy spent in producing these is transferred to the fewer but larger live trees. A plantation has the drawback that the trees are in early youth more branchy than when the crop is raised from seed : but this defect soon ceases to be perceptible ; it is, however, not improbable that the rapid development of a plantation compared with a sown crop impairs the quality of the timber rendering it less able to withstand the attacks of fungi later on.

But probably the best method of starting a wood is by natural regeneration ; it has the merits of cheapness, combining reproduction with shelter for the young crop against frost, drought, and weeds, while never exposing the soil to the sun, wind, and rain, and producing thicker crops leading to cleaner stems. The drawbacks are that greater skill is needed in the forest staff, that one is to some extent dependent on the occurrence of a seed-year, leading to a certain lack of control and definite precision in laying down steps to be taken in the future, that the young crop is sometimes patchy and of uneven growth, and that some increment is lost by the retention of the shelter trees. But in spite of all these disadvantages there is no doubt that any forester will utilise natural regeneration in reference to artificial whenever he reasonably can. The growth of weeds such as docks, nettles, thistles, brambles, bracken, grasses, etc., in Britain and the almost invariable presence of ground game preclude the adoption of this method except when the production of timber is treated as the chief consideration to which everything is subordinated. This implies the formation of large uninterrupted blocks of forest, which among other advantages have for natural regeneration the special good point that weed seeds cannot be carried by the wind all over the forest soil from the lanes and fields. Crops can be produced by natural regeneration only when the ground is already stocked with the species desired. If a new kind of tree is to be grown or if the ground is bare, the problem of what to plant has first to be settled, and this is by no means the simple matter it is sometimes held to be. First of all the rule-of-thumb method one has known adopted of sending down to the nearest timber merchant and finding out what timber fetches the highest price and forthwith planting that species, though possessing the merit of simplicity, has little else to recommend it. The factors determining the selection of the species are very numerous : it must be capable of maintaining the fertility of the soil either pure or in mixture ; it must be able to resist special local dangers like wind and frost, and it must ; suit the local market ; it must suit the soil and climate (it is no use growing Douglas fir or sweet chestnut on chalk, nor ash on

dry sand, nor larch on a swampy moor); often it is a matter of elimination; one or other feature of the locality will rule out species after species until sometimes nothing is left but Scots pine which accommodates itself to the poorest situation. A practical piece of advice is to make an excursion among the trees in the neighbourhood and examine the soil where any sort is found most thriving in order to determine how far it corresponds with that intended to be planted. As a general indication the height of a tree will always tell whether the locality suits it or not. In an unsuitable situation a tree will never grow tall. Elm wants warmth, ash wants shelter, alder wants moisture, oak wants depth, beech and hazel want mineral richness. Maritime pine can't stand chalk, spruce gets blown over by the wind, silver fir won't grow in dry air. While determining the species to be grown first and foremost by the quality of the soil and the character of the climate, the value of the different species should undoubtedly exercise considerable influence. But I cannot too strongly impress upon you that no species should be planted, however valuable it may be, unless it is capable of doing thoroughly well and forming a dense canopy. An open straggling stag-headed wood is unprofitable in itself and ruinous to the soil besides being an attraction to predatory insects and fungi.

As a rough generalisation, Douglas fir spruce, and silver fir produce the greatest volume of timber in pure crops when on soil that suits them. Larch and ash give the greatest average production when felled at 70 years, Scots pine 80, spruce 90, beech and silver fir 120, and oak 130.

The problem of forestry always resolves itself into how to raise the crops most suited to the object the landowner has in view under given conditions; and the first step necessary in taking over charge of a forest in bad condition (as all forests always are—there is no forest in the ideal state) is to bring the production of timber per unit of area up to its maximum. It is the growth, or as foresters express it, the increment alone which renders the standing timber an active capital; so any blanks must be stocked up at once, and any wood whose rate of growth is obviously below that which

could be produced on the same area must be removed and replaced with more vigorous growth. The capital invested in a forest is represented by the value of the soil plus the value of the standing timber and the interest on the capital is the annual increment caused by the growth of the trees. Not only does the volume of the timber steadily increase, but the value per unit of volume increases too. A pinewood 60 years of age contains 4,310 cubic feet per acre, and at 70 years it will contain 5,160 cubic feet, but the 70-year-old wood is worth more per cubic foot than the 60-year-old wood. The proportion between the value of this annual increment and the value of the soil plus the value of the standing timber represents the interest yielded on the capital, and it is obvious that though the value of the soil remains steady, the value of the standing timber yearly increases, the capital thus accumulated amounting to a very large sum. The rate of growth varies slightly but not very much and so a time must come when the proportion between the annual increment and the capital culminates. Usually this proportion is expressed as a percentage and called the forest rate per cent. In early life as the value of the standing crop is slight this rate will be high, and it will gradually sink to 2½ or 3 per cent about the 80th year in the case of a pinewood, and subsequently to 1 per cent and less. According as the owner fixes 2, 3, or 4 per cent as the rate of interest he demands from the capital locked up in his forests, so is the financial maturity of any wood determined. Supposing he fixes 3 per cent when the annual increment compared to the soil value plus the value of the standing timber bears the ratio of 3 to 100 then the wood is ripe for the axe. But the determination of the rate of interest which can reasonably be demanded from forests is no simple problem. Compared with agriculture which in this country yields on an average 3 per cent, it has to be remembered that while a return is drawn from agriculture every year, the income from forestry remains locked up with the capital accumulating at compound interest until the final fall of the crop. Forests give a very steady revenue, which practically changes very little—nothing like the returns from field crops nor like the revenue to be derived from Consols, which have

varied in 10 years from 83 to 113 representing 12 years' interest clear loss to anyone obliged to sell now. Forests once brought into a proper condition yield an absolutely steady revenue subject to less changes and fluctuations than any other investment I know. Considering this, and the security of the capital, and the continually increasing demand for timber per head of population in spite of all substitutes that are introduced, the rate of interest one can reasonably expect from forests is usually taken in Europe from 2¼ to 3¼ per cent, and when conducted on a large scale a larger return than this cannot be looked for. I have known a forest that paid 10 per cent but this was very favourably situated near mines; the Saxon forests extending over 450,000 acres yield only 2½ per cent on their estimated value—about £18 million. But forestry is no investment for a get-rich-quick speculator. It is properly a means of developing the latent productive capacity of the soil suited to states, or communities who pay no death duties, who can ensure continuity in management and general policy and who can insist on regular and periodic accounts—it is a great rarity for the books of a private forest in this country to be kept properly showing expenditure and revenue for each unit of area. The carelessness in this respect shown even by some of the most enlightened forest managers is almost incredible. Not only the direct money profit but the indirect benefit is to be considered, the power of affording employment to 10 men instead of one as when sheep-pasture is put under forest. To maintain 1,000 acres of sheep-pasture requires one man, but 1,000 acres of forest afford permanent employment to 10—12 men while at the same time yielding a higher income than a sheep farm. A few figures may be of interest. Germany has 27 per cent of her total area under forest, and the average net income from the whole is *7s.* per acre; one million families are estimated to be supported by the forests of that country, 200,000 in the administration of the forests, tending, planting, and so on, which costs £8 million a year; 100,000 in the transport of the timber costing £4 million, 600,000 in the utilisation of the produce costing £30 million. This means that £40 to £50 million is economically spent on productive work, and

5 million souls obtain a livelihood. A point often overlooked in considering forestry as a market for labour is the way it fits in with agricultural work. It is in the winter that there is most distress and least work; in the summer work can be found in the fields, and it is in the winter that the bulk of forest work is carried out, both planting and felling. It is often the case that provided there is a forest near by where a man can find work in the winter, then he can run his farm, but if there is no chance of anything extra to do during the cold months he cannot earn enough to keep himself through the winter, and so the farm is deserted. The small farmer cannot get on without a forest to give him work in the winter, and the forest cannot be economically managed unless its winter temporary staff of fellers and planters can find other work in the summer.

A Normal Forest is the expression used when the possibilities for timber-production of the soil are being utilised to their utmost and a steady income is being obtained varying scarcely at all in quantity. To take a definite example, if 2,000 acres of land are under pine that is most profitably marketable when 100 years of age, then there will be in the ideal forest 20 acres of pines 1 year old, 20 acres of trees 2 years old, 20 acres 3 years old, and so on up to 20 acres 99 years old and 20 acres 100 years old. This last block of 20 acres is mature and is felled at once. Its volume, say 160,000 cubic feet must be equal to the annual increment of the whole 2,000 acres, that is to the amount of timber being put on by the natural growth of the trees; each acre of the 2,000 acres puts on in one year 80 cubic feet, its increment is 80 cubic feet and for the 2,000 acres the increment is 160,000 cubic feet, and the annual fall must equal this amount. As soon as the mature 20-acre wood is felled it must be planted up to avoid loss of soil-productivity and exposure of the soil. Next year the present 99-year-old wood will be 100 years old and that will be felled and restocked, and so on. This is the perfect forest, and though rarely, if ever found in practice, it affords a useful illustration of the ideal at which to aim, and of the proper aspect from which to view a whole forest looked at as an economically

productive unit. It is a principle that the annual yield or annual outturn should be equal to the annual increment, and an equally sound rule is to fell no timber until its replacement with trees of no less vigorous growth is assured. The maintenance of a constant volume of standing timber (called the growing stock) resulting in a steady equal annual outturn must be one of the aims held in view. Without this there can be no regular market, no possibility of a local industry drawing its supply from the forest, like the chair-making industry at High Wycombe, which draws its supplies from the beech forests of the Chiltern Hills, no certainty of obtaining the same labour year after year which thus becomes highly skilled and no possibility of forecasting receipts and expenditure without which no big scheme of roads or transport or development generally can be undertaken. It needs no further pressing the point about the steady equal annual yield. But the cruelly high railway freights for freight on British timber, and the extent to which proprietors are in the hands of timber merchants are both in no small degree due to lack of recognition of this primary principle. And here I should like to point out how the financial, actuarial, or economic side of forestry has been neglected in the past ; any system of administration, political or agricultural, must be based on sound finance ; a knowledge of elementary economy and the capacity to grasp the actuarial aspect of a forest proposition are to my mind at least as essential as an intimate acquaintance with tree physiology and the general conditions of plant life. Forestry is an industry based on science.

Much has been said about the effect upon the climate of maintaining a dense forest. The general effect is known, but it is a very difficult thing to prove. That the destruction of forests has had most disastrous results is a matter of common knowledge. The Hoshiarpur Chos in the Punjab is a well known instance. In 1848 owing to the British annexation the population increased, cattle increased, and the demand for wood and charcoal rose with the result that the Hoshiarpur hills were denuded of their protecting forest growth, the surface was eroded and broad rivers of sand were washed down and spread over the fertile plains below turning

70,000 acres of fertile fields into desert and rendering the inhabitants of 914 villages unable to find a means of subsistence. That is one concrete example of the result of destroying forests—a similar thing is seen in Persia, once one of the granaries of the East, and in North Africa formerly the main source of corn-supply to Rome. There is no question that clearing forests has a bad effect, but that maintaining forests causes improvement is not a necessary corollary. Certain points are clear; the temperature in a forest is cooler during the day and warmer during the night than on bare land, extremes are mitigated and the temperature is made more equable. Evaporation from the upper layers of the soil is reduced and the relative humidity of the air is increased, while the soil is protected and improved. The forest acts as a huge sponge; when rain falls, it cannot flow away so quickly as on bare land; the humus soaks up a great deal, while much is retained on the leaves and trunks to fall later; in this way the water coming down in a shower is not all immediately delivered to the soil, but only gradually, so that the earth has more time in which to absorb it. This is the reason springs are perennial when in a forest but often dry up if the forest is cut down.

But it appears probable that the climatic influence of forests is limited to their immediate vicinity; they shelter fields against scorching winds and they increase the moisture in the air thereby causing the dew to be heavier in their neighbourhood.

CORRESPONDENCE

## IMMUNITY OF ANIMALS TO SNAKE BITE.

When the late Dr. Blanford wrote his excellent volume on mammals—now, by the way, sadly out of date and urgently in need of a new edition—in the "Fauna of British India," our knowledge of bacteria and microbes was in its infancy. Consequently, when discussing the reason why the mongoose attacks and kills venomous snakes without being harmed itself, it never occurred to him that the creature was naturally immune to snake-poison. He suggested, indeed, that the mongoose owed its safety to its own agility and the thickness of its coat. But when one comes to think the matter out, such supposed means of defence are really quite inadequate; and the native idea that the mongoose hunts out and eats a particular plant which acts as an antidote to the poison of its victim is in reality a mere philosophical theory. In fact the native idea practically hit the nail on the head, for the mongoose really has an antidote against snake-poison, only that this antidote is naturally in its own blood and has not to be sought elsewhere.

But, as the result of modern bacteriological investigation, especially on the part of Professor G. Billard of Clermont Ferrard, France, the mongoose is by no means the only species which enjoys this immunity; and it seems probable that in the case of a large number of animals which habitually feed on snakes or are brought much into contact with them, the poison of the most deadly reptile in the world is of no effect.

In making experiments of this nature, it is essential to know the history of the individual animals experimented upon, in order to avoid the possibility of their having become immune to the venom by inoculation without being inherently so. The best way, of course, is to experiment upon animals bred in confinement, but when this cannot be done, the next best method is to take the young ones at an early age and rear them in cages.

In the case of the large French dormouse, known as the Cerot, Dr. Billard was able to follow the former course; and succeeded thereby in proving that this species is completely immune, as had been previously proved by another investigator, also French, in the

case of the mongoose. As what holds good for one species will probably also obtain in the case of its immediate relatives, it may be assumed that all kinds of mongoose are unaffected by snake poison.

Another animal proved to be immune is the badger, from which it may be inferred that other members of the same group enjoy a similar immunity. The domestic cat was likewise experimented upon, with similar results. One of the cats under experiment was bitten by a viper in the belly as it jumped over the reptile, with the result that the fangs of the latter were broken off and left in the wound. Beyond a certain amount of sickness and local irritation, this cat was practically none the worse; but, strange to say, the viper died from its injuries. From this immunity of the cat it is inferred that most, if not all, of the largest feline carnivora are likewise unaffected by the venom of serpents, an immunity which would, of course, be of great value to them in their jungle wanderings, when they are exceedingly liable, no doubt, to come into contact with these reptiles.

Ducks and owls appear to be likewise endowed with the same immunity, as no harm ensued after specimens had been bitten by vipers; and from this it seemed probable that cranes, herons and storks, which frequently kill and devour snakes, and almost certainly secretary birds, which live upon them, are also immune.

The results of other experiments which Dr. Billard proposes to undertake will be awaited with interest.—[*Indian Field.*]

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## FORESTRY IN NEW SOUTH WALES.

There is a tendency all over the world just now to confess that we have been more rapacious than wise in dealing with the magnificent legacy of timber offered us by our virgin forests. Here is New South Wales confessing: "*Like most young nations* we have, in the process of development, overlooked the importance of conserving forest wealth, and in this connection the opinion is ventured that few civilised countries can show a record of apathy and neglect that is worse than our own." We doubt it. When

countries like the United States and Canada can annually permit thousands of square miles of their forests to be wiped out by fire, destroying townships and roasting their inhabitants, we think New South Wales must be, by comparison, blameless. The total wooded area of the State containing timber of commercial value is, however, only 15 million acres, and any neglect of this compact property naturally attracts more attraction than losses in the huge and scattered areas west of the Atlantic.—[*Indian Engineering.*]

## ANTELOPES AND SLEEPING SICKNESS.

An important investigation, the report of which appears in a recent issue of the Proceedings of the Royal Society of London, has recently been undertaken by the Sleeping Sickness Committee with a view of ascertaining whether antelopes can act as reservoirs for the virus of that dread disease. It appears that, with the object of checking the development of Sleeping Sickness, some two and a half years ago man and domesticated animals were removed from the Uganda shore of the Victoria Nyanza, the haunt of the disease-producing tsetse, while more recently a similar clearance has been made of the islands. The effect of this depopulation has been to convert a two-mile belt on the northern shore of the lake into a game reserve abounding with water buck, bush buck, reed buck, situtunga, hippopotami, bush pig, etc. The game wander freely on the shore of the lake, and small herds of antelopes may frequently be seen on the grassy hillsides.

In spite, however, of the removal of man and his domesticated animals, the disease-producing tsetse continued to infect susceptible animals up to March 1910; and the question consequently arose whether antelopes could be the means of its propagation.

In the hope of solving the problem, the Commission proposed the following lines of enquiry :—(1) Can antelopes be infected with Sleeping Sickness by the bites of tsetse bred and infected in the laboratory ? (2) If they can be so infected, are they capable of

transmitting the virus to laboratory-bred tsetse when the latter are allowed to feed upon them? And also if tsetse can be so infected, can they communicate the virus to susceptible animals? (3) If such infection of tsetse is possible, what is the percentage infected? (4) How does infection with Sleeping Sickness affect the health of the antelopes? (5) Are antelopes dwelling in the fly-area naturally infected with Sleeping Sickness?

As the result of the investigation, it appears that (1) water buck, bush buck, and reed buck can readily be infected with a human strain of the trypanosome of Sleeping Sickness by the bites of infected tsetse. (2) Such infected antelopes are capable of communicating the virus to clean laboratory-bred tsetse. And tsetse when infected by this means with the virus of Sleeping Sickness can transmit it to susceptible animals. (3) An appreciable percentage of tsetse will become infected with the virus if they feed on antelopes suffering from the disease. (4) Infected antelopes may live for several months without apparently suffering in general health. (5) No antelope has hitherto been found naturally infected with the trypanosome of Sleeping Sickness.

From this it may be regarded as certain that antelopes living in the fly-area are capable of becoming potential reservoirs of the virus of Sleeping Sickness. Whether they can be naturally infected is, however, a point which it is extremely difficult to determine; but there are indications that such may but improbably prove to be the case. If this should turn out to be true, it will be a very serious matter indeed; and the only course would be a war of extermination against the antelopes in the fly-areas. Even, however, if this were done, others would soon take their places, so that it is difficult to conjecture where the work of extermination could stop. But whatever be the cost, and however we may deplore a fresh onslaught on the already fast-diminishing African antelopes, nothing must be allowed to stand in the way of endeavouring to stamp out such a terrible disease as Sleeping Sickness.—[*The Indian Field.*]

NOTES.

**A new rubber producing tree.**—According to latest advices from South Africa there is little fear that the supply of rubber will be unable to meet the ever-increasing demand for that useful and expensive substance. The Tirucalli tree, which is such a feature of the forest landscape in the north of Natal, is stated to be capable of providing a practically unlimited quantity of the finest qualities of rubber. The exudation which flows copiously from an incision in the bark of the Tirucalli hardens rapidly into a resinous mass. Hitherto the substance has been deemed a product of no commercial interest or value. But numerous analyses recently made by eminent chemists in London of some large samples sent over from Durban have revealed the fact that this unpromising material contains from 10 to 20 per cent of pure rubber, and that when the resin and the rubber are separated by suitable solvents each is found to be of the highest quality in its own sphere. The samples of rubber that have been extracted in Natal by the most primitive of means show a quality approximately equal to 60 per cent of best hard Para, and that improved methods of treating the latex when freshly drawn from the tree will result in a quality of rubber but little if any inferior to the finest plantation smoked sheets. The Tirucalli tree is quick-growing and self-seeding, and exists in numbers which can only be estimated in millions.—[*Capital.*]

**Longevity.**—The problem of longevity is being studied not only from the mortality records of human life, but similar records are now being kept of animals in captivity, in order that the conditions for keeping them alive may become better understood. Various life spans were lately reviewed by Dr. P. Chalmers Mitchell at the London Royal Institution. The classic example of extreme age in man is Thomas Parr, or "Old Parr," who died in London in 1635 at the reputed age of 152 years, and two or three others have been credited with reaching 140 years or more. While these figures are questioned, persons are certainly known to live considerably more than 100 years—the number being now on the increase. Man's nearest relatives—the chimpanzee, orang and gorilla—probably live 60 or 70 years, although the smaller apes do

not exceed 25 years. Lions, tigers and bears may reach 45 or 50. Of other life possibilities, as near as can be determined, that of the elephant is 100 years; rhinoceros, 50 or 60; horse, 40; deer, 40 or more; cattle and sheep, domestic cat, and squirrel, 20; eagle, over 100; owl, 80; parrot, over 100; raven and crow, 70; ostrich, under 40; goose and duck, over 30; canary and some other small singing birds, 20 to 30. Men, whales, eagles and parrots are the only animals exceeding 100 years. Few animals, however, reach the greatest possible age, as the average length of life depends upon enemies, accidents, disease, and living conditions.—[*Capital.*]

**Oxford University.**—We are glad to note that Mr. A. M. F. Caccia, Deputy Conservator of Forests, has been appointed as a temporary measure to succeed the late Mr. W. R. Fisher as Lecturer in Forestry. We trust that Mr. Caccia will be selected to succeed Sir William Schlich who, we are given to understand, is contemplating retirement.

**Imperial Forest College.**—Fifteen students have been admitted to the 3rd year course beginning on the 1st July. In next month's issue will be shown the number of nominations assigned to each province.

**The Reporter on Economic Products.**—We believe that this post is to be abolished to a great extent as a separate entity and that the files will be distributed among the Forest, Agricultural and Geological Departments.

**The Coronation Procession.**—We understand that Mr. P. H. Clutterbuck, the late Editor of the *Indian Forester*, a Major in the United Provinces Light Horse, and A.-D.-C. to His Honour the Lieutenant-Governor of the United Provinces of Agra and Oudh, has been selected as one of the Officers to represent the Indian Volunteers in the Coronation procession in England.

**Forest Flora of the old School Circle, United Provinces.**—We are informed that a new edition of Rai Sahib Upendranath Kanjilal's Flora, on which he has been engaged for some time past, has been published. It can be obtained from the Superintendent, Government Press, Calcutta.

VOLUME XXXVII NUMBER 7

# INDIAN FORESTER

*JULY, 1911.*

## PENSIONS.

A correspondent writing to the May number of the *Forester* drew attention to the inadequacy of the pay and pension conditions of the Department, though the special object of his letter was to show that the pay as laid down under the incremental scheme had been to his disadvantage.

We think that his case must have been an exceptional one of individual hardship and one that has not affected to any extent the service at large. If, however, he had criticised the pension rules he would have had the whole of the service at his back. We have been more than once asked to examine these rules, express our opinion as to their adequacy, and, in the event of our considering them inadequate or unsuitable, to show how they can be improved and placed on a fair and reasonable basis. We have hesitated to do this as we had heard a rumour that the question was before the Government of India, but as nothing seems to have come of it, and as it is one that affects the interests of the Department at large, we see no objection to its discussion in the pages of the *Forester* and will welcome any correspondence under this head.

In the following remarks we place on one side "invalid" pensions which are on an altogether different footing, and with which we are not dealing.

An examination of the existing rules regulating the grant of pensions leads us to think that they are not wholly satisfactory either to the employer or the employé, quite apart from the fact that pensions are paid in a currency not in force in the country whence the pension-holder was recruited, and where he may be reasonably expected to reside.

Dealing first with the 4,000 rupee pension after 18 years' active service, here it is the employer that has cause for complaint, why should he offer any inducement to an officer to retire when he is at his best? We think that this pension should in the interest of the employer be abolished except on medical certificate.

Coming next to the 5,000 rupee pension after 25 years of service, what strikes us first of all is, why should the same pensionary period of service be applicable to various Departments, the conditions and circumstances of which are totally different?

Service in the Forest Department entails a severe physical strain on its officers, induced by its attendant conditions and the various discomforts inseparable from a life spent in unhealthy surroundings, is it then to be expected that the efficiency of an officer will last as long as in another Department in which the amenities of life are superior and the physical strain less considerable? Why should not the length of service held to be necessary to qualify an officer for pension be based upon the conditions obtaining in each Department? Again, why should the employer be forced to retain an officer if he is inefficient after 25 years' service? If he wishes to retain him, that is to say, if his services are after 25 years considered of high value, then surely the employé is entitled by all the rules of equity to a higher pension than the man who is pensioned on 25 years' service, especially as the former will in the natural course of events enjoy his pension for a shorter time. Further, in connection with the extra pension to which an officer under existing rules becomes eligible, we need only say that the last amendment to the Civil Service Regulations has

rightly or wrongly (and on this we express no opinion), given rise to an undercurrent of discontent in the Department in every way regrettable. The above points and a length of service in place of an age limit as the pension qualification to which we will allude later on, strike us as being the chief anomalies in the pension rules. There are very possibly others; the fact that such anomalies exist would seem to demand a revision of the rules. Lessons from past history have shown the expediency of removing anomalies which give rise to great discontent before this latter comes to a head. We propose to examine the rules and suggest improvements with special reference to the Imperial Forest Service.

The first aspect of the case that strikes us is the impossibility of upholding the grant of a rupee pension to one home recruited service and that of a sterling pension to another service recruited under similar or very similar conditions. This seems to us to be an anomaly that cannot be justified or explained away with any show of equity. The origin of this dual method of payment is somewhat difficult to trace. It would appear that at the time when there were only two services in India of any importance, the Civil Service and the Army, pensions were quoted in sterling or in both currencies at a fixed rate of exchange, and on the abolition of the Company, the British Government had to respect vested interests and hesitated to change an old custom, fearing perhaps powerful opposition; moreover at that time it was very probably not considered of much importance as to whether a pension was expressed in sterling or rupee currency. As the other Indian Services, which we will term the Subsidiary Services, were created, recruitment was under fluctuating conditions, some men were appointed in England, some in this country, and the pension appears to have been quoted only in rupees, though we are not sure that this was done in every case (in the case of furlough allowances it certainly was not), nor was exception taken to this as it was not for a moment realised that there would be any divergence in the value of the rupee from its then sterling quotation. Had these Subsidiary Services been formed entirely of home recruited officers and had they been formed earlier in the last

century, we believe that the pension would have had a sterling quotation. We consider it as fact absolutely beyond dispute that at this early stage *the intention* was that on the completion of his service, generally perhaps 25 years, in these Subsidiary Departments, an officer should draw £500 at home or Rs. 5,000 in India, and it is in our opinion *this intention* that should form the starting point of any revision of the pension rules.

To proceed, we would lay stress on the fact that a pension has been publicly stated by a responsible Minister of the Crown in the House of Commons to be in the nature of deferred pay. In creating pensions therefore there is no getting over the fact that a certain portion of an officer's pay was deferred for the purpose and afterwards given him in the form of a pension : that the portion deferred was such as was considered sufficient to ensure him a competence after retiring, and this was, as we have stated above, originally intended to be at the rate of £500 a year at home or Rs. 5,000 a year in India after a certain length of qualifying service, allowing for certain periods of leave. When this sum was fixed, we hold that there was absolutely no intention of ever assigning less than £500 after the qualifying length of service, to a home recruited officer living in Europe on his retirement, whatever the sterling value of the rupee might be, nor less than Rs. 5,000 in India. In other words, the intention was to pay an officer his deferred pay at a fixed rate *in the currency of the country in which he might be expected to settle down after retirement.* The same fact was more clearly brought out in the case of an officer's furlough allowances, and there are instances of these having been actually quoted in sterling, it having been taken for granted that a home recruited officer would spend his furlough in Europe. This is our first point.

Two facts are now apparent :—

(*i*) The cost of living has so increased that an officer cannot live in the way that it was originally intended that he should after his retirement on £500 per annum.

(*ii*) The percentage of his pay that has been deferred to give him his pension has been considerably decreased,

in spite of (*i*) above whether his pension be drawn in India in rupees or in England in sterling, because, though he draws more pay if calculated in rupees, his pension in that currency remains the same, or, his pay as calculated in sterling remaining approximately what it used to be, the sterling value of the deferred portion of it is considerably less.

These two reasons give additional force to our first point should any such be required, namely, that £500 a year should be the minimum pension in the case of officers retiring to Europe after putting in their qualifying service.

Again, the status of officers of the Subsidiary Services is now vastly different to what it has been in the past. Nepotism and interest, so conspicuous in the past, have given place to the public recognition of professional merit, thus officers who formerly could not expect to fill high administrative posts now do so, and form very possibly an essential part of the machinery of the Government of India. Is it to the credit of this Government or to its interest as offering any inducement to the most promising candidates to come forward, that these latter, as also the general public, should see a high Indian official on his retirement suddenly relegated to a side street in a provincial town or forced to avail himself of the hospitality proffered by a foreign nation? That this has not been altogether lost sight of is evidenced by the fact that such officers are eligible for additional pensions, inadequate though they be.

Our second point then is that for conspicuous merit recognised as such by appointment to high official position, adequate additional pensions are called for. Such are also called for by the fact that as pensions are deferred pay, and thus presumably are intended to bear some proportion to the actual pay drawn, those of high administrative officers should be proportionately increased.

We have seen that the original intention was that an officer was entitled to a pension of £500 a year after a certain period of service, (25 years in the case of the Forest Department), in other words, the Secretary of State told the officer that after 25 years he would be entitled to retire on the normal pension. We

consider this contract not sufficiently explicit both in the interests of Government and of capable officers. It should in our opinion be expressly laid down that the Secretary of State engages the services of an officer for 25 years, and on completion of this period of service will pay him a pension of £500 a year, but if he sees fit to re-engage him on terms to be mutually agreed upon, then a fresh contract comes into force. This procedure would permit of the Secretary of State getting rid of an unsuitable official at a given moment, while it would also permit of his retaining the services of a thoroughly efficient officer, besides incidentally it would offer an incentive to good work. If, however, an officer is thus re-engaged, it stands to reason that in equity he expects to have some increase to his £500 pension, in proportion to the further number of years that he remains in harness and to the lesser number of years that he may expect to draw a pension. This is our third point.

If some agreement can be come to towards the acceptance of these three points, then the question of pension becomes one of comparative simplicity. Before going into this, however, we would like to incidentally note on the 25 years that we have assumed to be the period of qualifying service. We dislike this arbitrary rule of 25 years as it affects officers differently. A reference to the list of Gazetted Officers will show that one officer has entered the Department at 28 years of age (though this is exceptional), while another was only 21. The maximum age of entry is always liable to alteration and has been not infrequently altered, and it affords small satisfaction—we go as far as saying a distinct grievance—to an officer pensioned at 53 to see his confrère drawing the same pension at 46. For the 25 years we would like to see substituted an age limit: assuming that generally an officer reaches this country at 23 years of age, we think that this age limit should be 48. With such a limit there would be a strong tendency to make the age of entry as uniform as possible and keep it suitably low (we consider its present maximum limit too high), as no employer, knowing that his workman may claim his pension at 48, would contract with him for 20 years' service, when he could

obtain 25 years' service from an equally good man by taking him when five years younger. Again, though this is somewhat outside the scope of the present article, we are out of all sympathy with the rule that lays down that an officer counts a portion of his furlough only towards qualifying service. If this qualifying service gives place to an age limit, this qualifying furlough period will automatically disappear, and this is as it should be. We prefer the rule in force in the Indian Army that furlough can be taken when an officer can be spared. This will not normally lead to applications for excessive furlough, since such will be restricted by pecuniary considerations. The point that we have reached is then that an officer should be entitled to a pension of £500 a year on the termination of his contract at 48 years of age, thereby giving effect to the original intention in respect to pensions; that high administrative appointments should carry special additional pensions; and that there should be a further additional pension on an officer's contract being renewed or extended by mutual agreement, for each year's extension. The next question is the amount of these additional pensions. We have little in the form of original intention to guide us as in the case of the normal £500 pension, any suggestions must therefore be of a somewhat arbitrary nature, though following perhaps to a modified extent the procedure in other Departments, such as the Army and the Indian Medical Service. We suggest £75 special additional for a Conservator, £125 for a Chief Conservator, and £175 for the Inspector-General. These exclude the extra pension to be earned as the result of extended or renewed contract which we think might well be at the rate of £25 additional for each year of service from 48 to 55 years of age.

The result of these proposals would be that the maximum pension of a Conservator would be £750, of a Chief Conservator £800, with £850 for the Inspector-General. Such a scale does not appear to us excessive as compared with other services drawing a sterling pension, on the contrary it seems to us fair and likely to afford satisfaction.

Here we must for a moment digress: we have heard the theory put forward that it is true that the pension that an officer draws

at home is considerably less than it was 40 years ago in spite of the increased cost of living and attendant expenses, but that this is as it should be, as he is now paid in India at a higher rate, enabling him to put by money. Is this so? It seems to us that the statement will not bear investigation. Let us look at the facts. Some 30 years ago or more one or two senior officers may perhaps remember that the rupee was equal to about 2 shillings and that the pay of Conservators was from Rs. 1,000 to Rs. 1,250 and that of a Deputy Conservator, 1st grade, Rs. 900 while now the figures are Rs. 1,500 to Rs. 1,900 and Rs. 1,250. So far the rupee pay has been increased, but the calls on an officer's purse are principally either in the form of sterling payments to meet home charges, or to meet such items as house rent, servants' wages, cost of European goods, and commodities, cost of ponies, grain, etc. Home charges and European commodities have either remained at the same sterling price as formerly, the rupee price having enormously increased, or have augmented owing to heavier duties being placed upon them, while there is no question that the price of servants, house rent, grain, etc., etc., has gone up 50 per cent to 100 per cent in most places. Allowing for the sake of argument that the sterling value of all these commodities has remained stationary (and we deny this, holding that it has increased in almost every case), has the sterling value of the pay of the Department remained stationary or shown any increase? It will be at once recognised that whereas Conservators were formerly paid £1,200 to £1,500 a year, they are now paid £1,200 to £1,520, while a Deputy Conservator, 1st grade, in place of £1,080 receives £1,000. Where then is the increase of pay in India that will allow of an officer putting by more money to balance the decrease in the sterling value of his pension?

Although any consideration of the Provincial Service pension is outside the scope of this article we make a passing reference to this. Its case is on a different footing to that of the Imperial Service since its officers are serving in their own country, as "natives of India."* They clearly have no claim to any sterling pension. Inasmuch, however, as they, that is to say the officers

* For a definition of "Native of India" see Art. 37 of the Civil Service Regulations.

of the newly created Provincial Service at any rate, take the place of officers of the controlling staff who used to be recruited *in India often direct to that staff and who were borne on the same list as the* home recruited officer, and were assigned a pension of Rs. 5,000, we think that this pension should be continued provided that it is not in excess of their half pay, though it should not be due till 30 years' service has been completed, or preferably till an officer is 55 years of age, this because, as noted above, the officer is a native of the country in which he is serving. In other words, the contract should be with these officers that they will be awarded a Rs. 5,000 pension at 55 years of age, or one equal to their half pay, whichever is less, the presumption being that if their half pay is less than Rs. 5,000, they have not been promoted as quickly as they might have been ; in other words that their service has not been of the highest merit all through, or that they entered as subordinates and were promoted to the controlling staff, in which case they cannot as a general rule in our opinion claim the same pension as officers appointed direct to the gazetted grades. In contracting with a Provincial Service candidate to give him a pension of Rs. 5,000 or half pay, whichever is less, at 55 years of age, there is not the advantage that we have proposed in the case of the Imperial Service, namely, the elimination of the undesirable element at 48 years of age, but there is a certain safeguard in that under the existing rules no officer is appointed permanently to the Provincial Service before he has undergone three years' probation.

What the financial effect of the above proposals would be we cannot say, we are not in a position to gauge this, having no data to go upon. They would no doubt entail increased expenditure, but against this must be placed increased efficiency, *i.e.*, that an officer would not be enabled to leave after 18 years' active service when he may be presumed to be at his best, while an indifferent officer would vacate at 48 years of age on his contract running out. This is as it should be, as the administrative grades would then be filled by the selection of the most efficient men and not merely by the exclusion of the most incapable, as has too often been the

case in the past. An officer not selected would be held to be of no further use in the Department and his agreement would not be renewed. He would therefore drop out, having failed in the race. This is all the more important at the present time, as a block in the Department is imminent, entailing increased competition for the administrative post, and any arrangement facilitating the appointment to them of the best men will be in the interests of the State.

In putting forward the above suggestions we lay no claim to infallibility, they are very likely open to improvement. What we do say, however, is that even at the risk of laying a somewhat heavier pension burden on the State, officers are justified in pressing for a fair rate of sterling pension and for a revision of the rules in force, in view of the anomalies contained in them. We doubt whether this recast of the rules will come at once or whether there will be any early development, involving the creation of sterling pensions, but we think it likely that in deference to the pressure of public opinion not only in this country but in England, our successors will enjoy very much better pension conditions than ourselves, and that the much needed changes cannot be very long deferred.

## PROVINCIAL FOREST SERVICE.

### NEW REGULATIONS.

The following resolution has been issued :—The Provincial Forest Service was constituted in 1891 and its present organisation is detailed in a circular resolution, No. 18F, dated the 29th July, 1891, under which the pay of the lower controlling staff (Extra Assistant Conservators) was fixed at Rs. 200, rising to Rs. 350, and that of the upper controlling staff (Extra Deputy Conservators) at Rs. 450, rising to Rs. 600, promotion being regulated by grades.

The Government of India have now obtained the sanction of the Secretary of State to the following arrangements for the revision of the emoluments of Extra Assistant and Extra Deputy Conservators.

*Extra Assistant Conservators.*—(*a*) An officer appointed direct to the Provincial Forest will, on permanent appointment to that service, receive pay of Rs. 250 a month, and his pay will thereafter rise automatically by annual increments of Rs. 20 a month until it reaches Rs. 550 a month ordinarily after 15 years' service from the date of permanent appointment to the Provincial Forest Service. Such an officer will count all periods of temporary or officiating service as Extra Assistant Conservator towards the increments whether such service has been continuous or for a broken period.

(*b*) An officer promoted from the subordinate branch of the Forest Service to the Provincial Branch will, on appointment to the latter branch whether permanent or officiating, receive a pay or salary, as the case may be, of Rs. 250 a month. His pay or salary will thereafter rise automatically by annual increments of Rs. 20 a month until

(*c*) after an officer has attained a pay of Rs. 550 a month he will not be entitled to any further increment of pay unless he is considered by the Local Government to be fit for a major charge. He will then be eligible for promotion to the upper controlling staff as Extra Deputy Conservator, but such promotion to the upper controlling staff will depend upon the occurrence of permanent vacancies in that staff on the fixed scale of each province. An Extra Assistant Conservator who has served for not less than three years on Rs. 550 a month, and who is considered by the local Government to be fit for a charge of major control, but for whom no vacancy exists in the upper controlling staff, may, however, be given a personal allowance of Rs. 50 a month, and in the case of officers whom the local Government considers fit for further increase of pay this allowance may be augmented to Rs. 100 a month on the expiry of a further period of four years, and to Rs. 150 a month on the expiry of a second period of four years. At present local allowances of Rs. 50 a month are admissible to Extra Assistant Conservators placed in charge of forest divisions, but the number of Forest Officers to whom the allowance may be given is limited to two in the Madras Presidency, two in the Bombay Presidency, and four in the rest of India. In future

any Extra Assistant Conservator temporarily placed in a major charge will receive a local allowance of Rs. 50 *per mensem*, but no officiating allowances of any kind will be given [the local allowance may be drawn in addition to personal allowance granted under clause (*1*) (*c*) of this paragraph].

*Extra Deputy Conservators.*—No officer may be promoted to the rank of Extra Deputy Conservator unless the Local Government considers him fit to hold a major charge, and except for special reasons an Extra Deputy Conservator should be actually placed in a charge classed as major. Ordinarily a vacancy in the upper controlling staff will be filled by selection from among the Extra Assistant Conservators receiving a pay of not less than Rs. 550 a month, or, in other words, from among men who have more than 15 years' service in the Provincial branch, but a local Government will be at liberty in making its selection to promote to such a vacancy an officer of less than 15 years' service. On promotion to the upper controlling staff as Extra Deputy Conservator, an officer will draw pay at the rate of Rs. 575 a month and will receive an annual increment of Rs. 25 a month until he draws Rs. 650 *per mensem*. After one year's service on this pay the local Government may by special order in each case promote an officer to a pay of Rs. 700 a month for a period of three years and again to a pay of Rs. 800 a month for a further period of three years and may then promote him to a pay of Rs. 850 a month until the close of his service; but promotion to the pay of Rs. 700, Rs. 800 and Rs. 850 a month should only be made when the local Government is satisfied at each step that the individual officer is thoroughly deserving of such promotion.

An officer who at the time of his promotion to the upper controlling staff was in receipt of a personal allowance under clause (*1*) (*c*) of this paragraph will retain such allowance only to the extent necessary to ensure that no reduction in his pay *plus* personal allowance shall result from his promotion.

Increments will in all cases be liable to stoppage by the local Government for unsatisfactory work or conduct.

The existing special and local allowances other than those mentioned in clause (*1*) (*d*) of this paragraph admissible under the

Forest Department Code and the Madras Code or under the orders in force in Bombay will not be affected by the orders as they are granted to meet special conditions which remain unaltered.

*Special Provision for Existing Officers.*—Existing officers of the Provincial Service should be brought on to the new scale of pay in the manner indicated below :—(*a*) All officers will come on to the new scale from the date of its introduction, but should this result in the diminution of the existing pay or salary of any individual officer he will retain the pay or salary he would receive under the present rules until he becomes entitled to a higher rate under the new scheme. (*b*) On coming on to the new scale each officer will receive the pay to which he would have been entitled, had he been throughout his service on the new scale subject to the following qualifications :—(i) If the local Government *is dissatisfied with the work or conduct of any officer, it may* prescribe a lower stage at which he shall enter the new scale. (ii) No Extra Assistant Conservator shall be promoted to be Extra Deputy Conservator under the new scale unless the local Government considers him qualified to hold a major charge permanently and a vacancy in the sanctioned cadre actually exists. If so promoted, his pay will be regulated under clause (*i.i.*) of this paragraph. Officers who are already Extra Deputy Conservators will be brought on to the new scale as Extra Deputy Conservators and draw pay according to the length of time which has elapsed since they were first permanently appointed Extra Deputy Conservators, provided they are considered fit to hold a major charge and that vacancies in the sanctioned cadres actually exist ; provided also that they will not draw more than Rs. 650 a month unless the local Government considers them fit for higher rates of pay. If these conditions are not satisfied the existing permanent Extra Deputy Conservators will receive Rs. 550 or their existing pay, whichever is greater.

The new arrangements will be introduced from such date not earlier than the 1st March 1911, as the local Government may, in each instance, determine.—[*Pioneer.*]

## INFLUENCE OF FORESTS ON ATMOSPHERIC AND SOIL MOISTURE.

This is a subject that has been for many years discussed, and from time to time various opinions have been expressed which, however, are not authoritative owing to the absence of data. In order to collect data which at some future time may permit of a definite opinion being recorded, the Government of India are asking Local Governments to move further in the matter.

The two main questions on which the views of the Local Governments were in the first instance asked for were—

(i) The effect of forest preservation on the rainfall or the underground water-supply.

(ii) The effect of forests in the catchment area of streams on the regularity and amount of supplies which had their origin in those catchment areas.

We understand that replies have been sent in from the various provinces but that the data furnished are inconclusive. This we can well believe. With regard to (i) above it must have been difficult to express any decided opinion. First of all it seems probable that there were no accurate figures available showing what the normal rainfall was, or what the underground water supply was before any forest conservancy took place. Then again although for many years past forest preservation has been carried out, data are not always available to show to what extent fire conservancy was practised, and if practised what the result has been.

Passing to (ii) it is almost impossible to lay down with any degree of certainty the effect of forest growth in the catchment areas on the regularity of the flow in, and the amount of water coming from these areas, though there is some evidence to show that the preservation of the forests has had a beneficial effect. If there were a normal rainfall every year we might venture some definite conclusions, but such must be to some extent rendered unreliable by periods of drought, by excessive rainfall during a limited period and by short and prolonged periods of rainfall

Moreover such data as exist are based probably on the observations and statements made by Range Officers and others, the information received from them being often untrustworthy and inaccurate. We well remember in the past when in charge of a Forest Division, supplying cheap watches in order that the duration of rainfall might be noted, and rain-gauges in order that the extent of the rainfall might be recorded. The results were most unsatisfactory—the Range Officers often handed the watches to ignorant guards who did not wind them or broke them, while their rainfall returns from the different gauges were so astonishing as to make it difficult to place any reliance upon them.

It may then, we think, be taken as established that the present data in our hands are generally too inaccurate to serve any useful purpose, and that in most places their collection must be taken in hand *de novo.*

The Government of India after consulting Dr. Walker, F.R.S., Director-General of Observatories, consider that a few experiments might now be carefully initiated in suitable localities with a view to affording information on the following points :—

(i) The local differences in the rainfall, temperature and humidity inside and outside forest areas.

(ii) The local differences in the level of the underground water table in areas near to, and far from, forest lands, respectively.

(iii) The local differences in the height and duration of floods after similar amounts and durations of rainfall in channels fed from forest and non-forest areas, respectively.

It is considered that it will be sufficient for the present to start these experiments in two or three localities only, and Local Governments are being asked to suggest localities best suited for each of the three experiments noted above, after consulting their Conservators. The localities would have to be selected independent, if possible, of outside factors such as those of altitude, and it must be a *sine qua non* that careful supervision will always be

available. It has been laid down that in experiments under head (*i*), the area selected should not be subject to irrigation and the places selected inside forests, respectively, should not be more than five miles from each other. In experiments of the class No. (ii) it would be necessary to take measurements of the water level in about ten selected wells in or near a forest and ten at a distance from a forest on fixed dates, and, if possible, the latter should be in areas not affected by irrigation. The experiments under head (iii) will present some difficulty and will require special treatment according to the circumstances of each locality. Once these experiments are started it is proposed that the results of the observations should be carefully tabulated and recorded by the Forest Research Institute at Dehra Dun.

The information which it is now sought to obtain is much on the same lines that we have endeavoured to collect in the past when our efforts were continually frustrated by the ignorance and apathy of the subordinate establishment and possibly by the indifference too often shown by the controlling staff. If experimental stations are confined to one or two localities in each province or presidency, as is intended by the Government of India, the chances of success will no doubt be greater, and after a long series of years it may be possible to draw definite conclusions.

We think that there can be no doubt that the direct effect of forests in catchment areas has in more than one instance been shown to be beneficial. This is a point that has long been recognised in Europe, where enormous sums have been expended to reafforest denuded areas with the object of preventing disastrous floods. The Government of India have recognised this and are accordingly suggesting to Local Governments that they should pass briefly in review the more important catchment areas of torrents, streams and rivers affecting cultivation, and consider whether some action such as stricter conservation or even reafforestation would not be advisable with the object of preventing further denudation or damage caused by torrential floods. In order that the subject may not be lost sight of, it is also suggested that it may be alluded to in annual reports.

If experiments on the lines suggested be carefully and continuously carried out, we believe that very valuable data may be in course of time collected, but it must be recognised that a long series of years must elapse before any reliable conclusions are possible. In Europe where the collection of such data has been long in force, the results are still often inconclusive.

We alluded above to the fact that the Government of India had consulted Dr. Walker on the subject. We have been supplied with a copy of his note which is in the highest degree interesting. We print it below :—

NOTE BY DR. G. T. WALKER, D.SC., F.R.S., DIRECTOR-GENERAL OF OBSERVATORIES.

For an authoritative summary of the results of European and American observations upon the influence of forests upon air temperature, ground temperature, humidity, rainfall, the run-off and the strength of the wind, reference may be made to the Handbuch der Klimatologie (Volume I, pages 186 – 193, 1908) by Dr. J. Hann, the greatest authority on climatology. The effects are in all cases small; in a forest both the air and the ground are cooler than outside the forest by something like 2° F., the percentage of saturation of the air by water-vapour is greater by about 10, and mist condenses freely on the trees. As regards rainfall, the amount falling inside the forest appears in Germany to be about 3 per cent larger than that outside. This does not, however, prove that the rainfall outside has been increased, and it is outside that it is needed for the growing of crops.

2. There are reasons, however, for thinking that in the tropics the influence of forests may perhaps be greater. There the drying influence of the sun is more powerful, and the shade of the trees might be expected to have more effect; also during the monsoon when the air is almost saturated the greater humidity and coolness over a forest might occasionally start the condensation of the vapour, and when this has been started it would continue automatically like an explosion of gunpowder to which a match has been applied; the clouds would probably drift away from the forest and so the rain falling on the crops might be increased.

3. As Blanford pointed out, the only satisfactory evidence would be that obtained by comparing the rainfall of a district when well supplied with forests with that of the same district when the trees were very few. His application of the principle to the southern Central Provinces is of sufficient importance to be briefly stated. He gives evidence that in that area prior to 1875, while five-sixths were nominally under forest, so much damage had been done by *dâhya* cultivation that by far the greater part of the forests had become devastated. He quotes the introduction of the Central Provinces Gazetteer of 1870, where Mr. C. Grant says :—

Indian Meteorological Memoirs, Volume III, page 136; or Proceedings of the Asiatic Society of Bengal, 1887, Part II, No. 1.

> "The tree forests of the Central Provinces have, however, been so much exhausted, mainly owing to the destructive *dâhya* system of cultivation practised by the hill tribes that, except in one or two localities, the labours of the Forest Officers will, for many years, be limited to guarding against further damage, and thus allowing the forests to recover themselves by rest. By far the greater part of the uncultivated lands belonging to Government are stony wastes, incapable of producing a strong straight growth of timber."

In 1875 the suppression of *dâhya* cultivation was taken in hand and with such success that in 1886 Mr. Ribbentrop wrote :—

> "My attention was directed, during a recent visit to the Central Provinces, to the extensive growth of young forests in areas formerly under *kumri* cultivation. Ten or fifteen years ago, such temporary cultivation was practised throughout the country, and thousands of square miles were thereby laid barren year after year. Since then, this method of cultivation was stopped, and, though a great part of the area affected was subject to annual fires, a more or less dense forest growth has sprung up."

Blanford then compares the rainfall of the area affected by forest preservation with that away from it; and shows that while

the rainfall in the preserved area, averaging about 50", was greater by 6·8" for the period 1876—85 than it had been for the ten years before, the rainfall in the remainder of the Central Provinces had diminished by 2·9". Blanford points out that the area in question, of nearly 50,000 square miles, is large enough to give reliable results, that its history is well known and considers that the only points on which doubt may be thrown are the reliability of the records and the sufficiency of the periods to yield valid averages. The results of the different stations are so consistent that I think the measurements may be trusted, and it would appear that there was an increase of about 9·7" (or 20 per cent) due to the growth of forest.

4. Unfortunately, however, it is clear that the periods are too short, and although the rainfall for the southern half of the Central Provinces averaged 48·0" from 1867 to 1875, and 54·6" from 1876 to 1885, the average has only been 50·6" since that time. For the Hyderabad State the averages for the same periods are 26·7", 32·2" and 32·6", showing a similar early improvement of 5·5", which has since been maintained. For the Mysore State the corresponding numbers are 30·2", 33·6" and 35·1"; and for the Madras Presidency 44·4", 46·4" and 46·2." Thus the changes in the southern portion of the Central Provinces extend fully over Hyderabad, and partially into the south of the Peninsula. Let us now see whether the changes in the northern portion of the Central Provinces are shared with Central India East. In the former area the average rainfall from 1867 to 1875 was 51·5"; it fell during the decade 1876 to 1885 to 48·5" and has since been 46·0"; thus Central India East, with corresponding amounts of 51·1", 43·9" and 45·1", show a much larger fall between the two first periods. Summing up then it may be said that the changes exhibited by the south and north of the Central Provinces extend in each case over a considerable area to the south and north respectively, and the difference between them must be due to varying distributions of the strength of the monsoon current, and not to local causes confined to the southern portion of the Central Provinces. Thus they cannot be regarded as explained by the improvement in forest condition, although the latter

may have played some comparatively unimportant part. Blanford also gives comparisons of rainfalls inside and outside forests at Ajmer and Dehra Dun; but, as already pointed out, I do not regard such experiments as deciding whether the forest causes an *increase of rainfall outside itself.*

5. In the papers submitted by Local Governments the chief arguments on this question appear to be those derived from Baluchistan and the dry area in Burma. In connection with the former it is stated that the forests have diminished materially, but that there has been no appreciable diminution in the rainfall. In the dry zone of Burma my instinct is that the rainfall always has been low, and that the destruction of the forests by human agency has made no perceptible difference to the rainfall, although it has probably led to serious denudation. We know that for periods comparable with eight or twelve years the rainfall may be high or low, and I would suggest the possibility that the traces of cultivation of a type requiring more rainfall than there is now may be due to one or more periods of abundant rain. If my impression is correct, the scantiness of the rainfall in the dry zone is almost *entirely due to the configuration* of the neighbourhood, the valley of the Irrawadi there widening out and forming a basin. It is true that the monsoon winds at the ground surface, as recorded by our observatories, run from south to north along the river valleys, whose gradients are fairly uniform, and that these winds would scarcely account for the rise in the rainfall of the valley north of Mandalay. But theory and observation in other similar places would indicate strongly that the upper monsoon winds are from the south-west; the Arakan Yoma *would thus* cause a *diminution* of rainfall in the low region sheltered by it to the east, and where the ground rises again to the east of the dry area the rainfall would increase because of the forced ascent against the hills, the air not having lost all its humidity.

On the whole, therefore, I believe that the effect of forests on rainfall is small, and probably does not reach 5 per cent.

6. With reference to the observations initiated by Blanford inside and outside certain forests, some historical remarks may be

of use. In the administration report of this Department for 1895-96, page 7, Sir John Eliot says :—

"The Ajmer Forest observations were started in the years 1884 and 1885 by Mr. Blanford and Dr. Brandis, under what appeared to these officers to be hopeful conditions for securing observations of the standard of accuracy required for the investigation of the important question at issue, *viz.*, the effect of forest growth in modifying the meteorological conditions, more especially the distribution of rainfall, in forest areas and also in the neighbouring open areas. The observers were paid from funds supplied by the Forest Department and were supervised so far as possible by the Deputy Conservator of Forests, Ajmer. An examination of these observations in 1887-88 showed me that they were very carelessly taken and were apparently of little value for the investigation. The observers were cautioned, but no improvement was effected. As the sanctioned arrangements to secure satisfactory observations had thus failed, I asked Mr. Murray, Meteorological Reporter to the Government of the North-Western Provinces and Oudh, to go carefully and systematically through the observations in order to find out how far they were of value, to trace the various sources of error and to visit the observatories and see under what conditions the observations were taken, and also to suggest the changes necessary in his opinion to secure, if possible, accurate observations in future. Mr. Murray submitted a very full and valuable report in January 1893 and suggested various changes including (1) simplification of the work of observation, (2) more efficient superintendence, and (3) more frequent inspection of the observatories. He also proposed that the observations should be sent weekly to him for examination, and that he might be allowed to correspond directly with the forest officer and the

observers. In this way he hoped to be able to detect as early as possible errors in the method of observation and to give the necessary instructions for the guidance of the observers and thus perhaps secure careful and accurate observations under uniform and unchanging conditions. These proposals were accepted by the Government of India, and Mr. Murray was instructed accordingly and asked to have twelve months' observations taken under these improved methods and then report on the character of the observation of that period. Mr. Murray submitted his report of the observations for the twelve months ending September 1895 in January 1896."

Upon the report which is quoted on pages 8-9, my predecessor remarks :—

"Mr. Murray's opinion, based on a very careful comparison of the observations of the twelve months, is that they were utterly worthless and of no value for the investigations for which they were intended, and that accurate observations of the kind required cannot be obtained by means of the present arrangements.

"The money cost of these observations, from their commencement in 1886 up to September 1895, has been approximately :—

| | | Rs. |
|---|---|---|
| (1) Pay of observers for about 10 years ... | ... | 2,400 |
| (2) Approximate cost of tabulation of observations | .. | 1,600 |
| Total | ... | 4,000 |

"In addition, a considerable amount of Mr. Murray's time, not to mention my own, has been wasted in proving that the observations were practically of no value.

"Mr. Murray suggested in his report more expensive arrangements, by which he thought it would be possible to secure satisfactory observations and results in future. The annual cost of these arrangements (excluding cost of tabulation of the observations in the Meteorological

Office and of their discussion by a scientific officer) would be about Rs. 1,500. As it would require at least five years' observations to give sufficient materials for the investigation of the effect of forest growth on meteorological conditions in Ajmer, the cost of the series of observations and discussion would amount to at least Rs. 10,000.

"The differences* are confessedly small in amount and hence can only be determined by careful, accurate and intelligent observation. In India it is only possible to secure accurate observations by employing scientific experts or by having them taken mechanically by cheap native agency under the supervision of an expert. It is a mere waste of money to arrange for observations of any kind in India, but more especially meteorological observation, without securing the essential requisites for obtaining observations of the degree of intelligence and accuracy required. As the Forest Department were not prepared to arrange for the intelligent and efficient supervision of the observations—which I considered a *sine qua non*—in order to obtain accurate and reliable observations, I suggested to the Government of India that it was not advisable to continue them, as their maintenance under present arrangement was a waste of money, and I could not recommend Government to undertake the larger and more expensive scheme suggested by Mr. Murray in the hope that perhaps satisfactory observations for the objects in view might be obtained. The experiment of these forest observations in India has been, I regret to say, an utter failure, and is one more example of the great difficulty of obtaining accurate statistics in India except by an expenditure which would be almost prohibitive even in a wealthy country like England."

The forest observatories were closed on the 1st May 1896.

* Between the meteorological conditions inside and outside.—G. T. W.

7. It certainly seems desirable to have definite and reliable information as to the climatic influence of forests, but the difficulty of securing accurate observations in outlying and lonely stations is always forcing itself upon me, and after the experience just described it is clear that such work should not be undertaken without considerable care.

## WANT OF A DEFINITE FOREST POLICY IN BURMA.

By "Op."

In the economic administration of a country the place which should be taken by forests has frequently been a matter for discussion and controversy. Before entering upon a detailed examination of the Forest Policy of Burma, it seems advisable to refer to some of the chief authorities on the subject. Judeich tells us that "The aim of forestry is the most advantageous utilisation possible of the area and soil set apart for the production of timber." This refers more particularly to forests where the main object is, as Nisbet puts it, "the production of the largest possible crop per acre of timber of the best possible quality."

Ribbentrop takes a broader view in his definition that—"A State Forest may be said to fulfil its highest function when it produces in a permanent fashion the greatest possible quantity of that material which is most useful to the general public, and which at the same time yields the best possible return to the proprietor." Schlich points in general that "State forests should afford the greatest possible advantage to the community as a whole," and that "State forests belong to the nation as a whole; by giving excessive privileges to a part of the people the rest of the nation is deprived of its legitimate rights," and in particular for India that "The first duty of future administrations must be to provide the enormous and ever-increasing native population of India with the necessary fuel, grass, and grazing, and with timber for construction, boat-building, tools and agricultural implements. Next, the forests must meet the increasing demands for railways and other public works. Thirdly, the exports should be increased

in so far as the forests can stand it without endangering the home supply. Fourthly, an endeavour must be made to develop the use of the numerous articles of minor produce which these extensive woodlands can yield."

The relations between the Forest Department and the General Administration in Burma are governed by the circular on the subject issued by the Government of India in October 1894. In accordance with this circular all State Forest Reserves are classified under one of the following four heads :—

(*a*) Forests whose preservation is essential on climatic or physical grounds.

(*b*) Forests which afford a supply of valuable timber for commercial purposes.

(*c*) Minor forests to be managed in the interests of the local population.

(*d*) Pasture lands, which may not be forests at all, but whose declaration as "Reserved Forest" is advisable to obtain settlement of rights.

Each of these classes will be considered separately.

FORESTS WHOSE PRESERVATION IS ESSENTIAL ON CLIMATIC OR PHYSICAL GROUNDS.

The Government of India lays down that in the case of areas coming under this head the interests to be protected are important beyond all comparison with the interests which it may be necessary to restrict. So far, so good. We now look for a statement of the provincial policy of Burma, and beyond a recognition of the fact that action of some sort is needed and a demand for reports we can find no plain exposition of the intentions of the Local Government to correspond with the general outlines laid down by the Government of India. There should be no further delay about the issue of a statement of policy with regard to this highly important class of forest. Instead of leaving matters to the personal influence and initiative of local officers, some indication should be given to what extent local interests are to be subordinated to

those of the whole community, and the various methods of compensating sufferers should be published with examples showing how each method can be modified to suit particular localities. The gist of the matter is the preparation of a comprehensive scheme to include the whole province, based upon considerations laid down in a circular of the Local Government stating definitely the policy to be adopted.

Not only do we note the absence of a declaration of provincial policy, but we find the Forest Department has prescribed no general principles upon which to base the management of such areas as may have been already reserved for so-called climatic or physical reasons.

The fact is, too many loose statements have been made by those who, drifting ineffectually among large aspirations, are not in a position to verify their ideas or to define their meaning. It is time to have done with this sloppy vagueness, and to summarise what is meant when mention is made of the "climatic benefit" conferred by the possession of forests on a country, and to clarify the standpoint of the Forest Department towards such proposals by stating plainly the objects for which these forests are to be maintained, *and by laying down the principles upon which they are to be managed to attain these objects.* It has not been our good fortune to see a single plan of management for one of these "climatic" forests.

In Government of Burma Resolution No. 1509, dated 30th November 1906, we find an assertion that "Experience in other countries has shown that the disappearance of forests is accompanied by a material diminution in the amount of the rainfall." Now Professor Schubert of Gottingen says that forests have no appreciable influence upon the rainfall and general climate. Endres says that woodlands do not increase the rainfall, but merely influence its distribution within the wooded area and its immediate neighbourhood. Nisbet tells us that "At high altitudes large extents of woodland probably increase the local rainfall considerably," because on the plains or near the sea other physical factors come into competition and modify the influence of forests. Schlich

shows that "It has yet to be proved whether afforestation in low lands affects the rainfall at all," and adds "On the whole there can be no doubt that, even under the most favourable circumstances, the climate and rainfall of the Indian plains are subject to other influences, compared with which the effect of a limited forest area must always be very small." Brandis sums up the whole question very well in his conclusion, that "The climatic influence of well-stocked forests is limited to their immediate vicinity. They shelter fields against scorching winds and they increase the moisture in the air, and thereby cause the dew in their neighbourhood to be heavier. *But the climate of the country cannot be changed.*" The investigations of Schimper and Haberlandt have proved that near tropical forests, in addition to the large amount of rain, the atmospheric humidity at night approaches saturation and during the hours of midday scarcely falls below 70 per cent, while near evergreen forests the relative humidity rarely sinks below 80 per cent, and in the afternoon varies between 97 and 99 per cent. Even in the hot weather at noon with a clear sky the lowest recorded is 79 per cent. Within the forest for weeks together it probably never falls below 90 per cent. Schlich likens the action of a forest to that of a sponge, and explains that "The larger the proportion of the catchment areas which is shaded by forest vegetation, the more favourable and *sustained* will be the supply of water." Even in 1851 the British Association at Edinburgh resolved that "In a country to which the maintenance of its water-supplies is a matter of extreme importance, the indiscriminate clearing of forests around the localities whence these supplies are derived is equally to be deprecated. It is a duty to prevent the excessive waste of wood, the timber useful for building and manufacture being reserved and husbanded." Von Fischbach points out, however, that "A revenue cannot be expected from protection-forests in real mountain tracts; indeed, a very moderate rate of interest on the capital value of the growing stock must be accepted, because the slower rate of growth demands much longer rotations and necessitates the accumulation of a greater volume of standing timber, without however producing higher yields of timber, while extraction is more costly."

Our conclusion is that the Government of Burma would do well to drop further references to the beneficial effect upon the climate of a country exercised by forests, and to confine their energies to the preservation and maintenance of forests in catchment areas and on steep slopes liable to suffer from erosion. Concentrated action in these directions demands the preparation of a provincial scheme.

Much damage is done in Burma by the practice of shifting cultivation ("taungya") in vogue among the poorer classes of the community and especially on the heights of the Shan States, the Chin Hill Tracts, and the Kachin Hill Tracts. It is for such localities that a sharply-defined indication of the view of the Local Government on the necessity of sacrificing local interests is particularly needed. Owing to the absence of a Government pronouncement to this effect, the recent special commission in the Kachin Hill Tracts has proved abortive. Originally constituted to preserve the forest-growth on watersheds and mountain ridges and to restrict "taungya" cultivation, local interests proved so strong that the measures taken degenerated into proposals for reserving certain woodlands situated (except in the case of one area of 1,000 acres) where the most optimistic critic could hardly be enthusiastic about their effect in maintaining a steady water-supply or in preventing erosion. To avoid friction with the tribes, the Central Government has been content to accept a sop in the form of certain Forest Reserve proposals in preference to taking a strong line in the interests of the whole community.

With a view to diminishing the harm done by exposing the soil under taungya cultivation, proposals have been made to sow up the cleared area after the crop has been reaped with quick-growing trees so as to shelter the ground from the sun, wind, and rain to consolidate the soil, and to add organic matter to the mineral subsoil. *Alnus nepalensis* has been specially brought to the front owing to its power of growing quickly at 5,000 feet and higher, though its crown is too open and its root-system too shallow to render it an ideal species for these objects, while the presence of nitrifying bacteria in the nodules of the roots of

the *Leguminosæ*, such as *Bacillus radicicola* symbiotic with *Robinia*, indicate the selection of a representative of that family as preferable. Unfortunately, with the exception of *Erythrina*, indigenous leguminous trees are rare at high elevations. No doubt the putrefactive bacteria *Nitrosomonas europæa* and *Nitrobacter* do good work in any case, but the wonders accomplished by *Clostridianum Pasteurianum* and *Bacillus Ellenbachensis* or *B. megatherium* show the sort of help that may be expected from proper attention to nitrifying bacteria. In this connection attention may be drawn to the conclusions of Professor Henry of Nancy:—

1. Dead leaves of all kinds, whether alone or mixed with earth, have the property of fixing a considerable proportion of atmospheric air, and especially when they rest on a damp substratum (clay, sandstone, or lime).
2. On a poor substratum of pure sand, dead foliage of beech, pine, and spruce, either does not (beech) become richer in nitrogen, or else the increase as very slight and insignificant (pine, spruce)—though in no case does it lose nitrogen.
3. Reliable experiments of this nature cannot be conducted in the forest on account of the action of earthworms. In fixing nitrogen by the dead layer of foliage various lowly plants are active (especially algæ, lichens, and mosses), as well as the special bacteria (*Clostridium, Granulobacter, Azotobacter*).

The mere notification under Burma Forest Act Rule 19 of areas in which taungyas may not be cut is not sufficient. Some substitute must be offered to the taungya-cutters, and co-operation between the Forest and Agricultural Departments is desirable. We believe that the total abolition of taungya cultivation among hill folk is for many years impracticable.

Experiments are necessary to determine the species most suitable for covering the ground during the intervals of taungya cutting, and care should be taken that the results of such experiments are tabulated and recorded. At present we can suggest no

native leguminous tree for high elevations except *Erythrina*, although *Alnus nepalensis* is a great deal better than nothing; and *Duabanga sonneratioides*, or *Albizzia stipulata* with bamboos for lower elevations. There is no reason to prefer a single species. A mixture is more likely to attain the desired objects.

FORESTS WHICH AFFORD A SUPPLY OF VALUABLE TIMBER FOR COMMERCIAL PURPOSES.

The Government of India has laid down that forests, rich in good timber, are to be managed on commercial lines and as sources of revenue to the State, but that the reasonable needs of the local population are to be supplied. The supply of large timber to merchants is not necessarily the most profitable system of management; it may be more in the interest of the people to supply the general and agricultural classes.

The provincial policy for this class of forest is again not laid down, and in this case there appears to be no real need for such definition as the interests of the Empire and of the Province are much the same. But the absence of a departmental notification prescribing professionally the general principles on which the technical management of the forests should be carried out is certainly a matter for surprised regret. The balance of advantage to the Province in favour of maintaining a steady outturn as compared with more thorough exploitation is a question each forest officer has to decide for himself on the spot: it should be part of a policy authoritatively determined for the whole Province by the professional heads of the Forest Department. We find the same lack of provision and organisation in other far-reaching considerations, such as the need to each forest division of a network of roads and paths, the number and distribution of rest-houses necessary to the efficient control of any area, the correct standpoint from which to regard the exploitation of forests not reserved nor likely to be reserved, the advantages and drawbacks of artificial compared with natural regeneration (*Cf.* Schlich, "The regeneration of the bulk of the Indian forests must be effected by natural means"), the extent o which species now valuable are to be encouraged at the expense of others now less valuable, and so on.

An authoritative pronouncement on some of the questions is not yet possible owing to the very imperfect knowledge of the indigenous species possessed by the Department. And this brings us to the most conspicuous shortcoming of those responsible for the administration of the Burma forests—to the glaring failure of the Forest Department to appreciate its own ignorance.

*There is no experimental forest garden.*

"When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind," says Lord Kelvin.

In a forest garden plots of pure and mixed forest should be maintained with the object of demonstrating the growth and development into timber of all important species under silvicultural as opposed to arboricultural conditions, a record being kept from the beginning showing the yearly conduct of each species. Additional objects held in view should be to give opportunities for demonstration, experiment, and practical instruction, as well as to afford an opportunity for studying the botanical characteristics of trees. Part of the area may well be park-like in order to produce fine individual specimens and good seed, and a small patch should be treated as a nursery. Experiments are needed in mixtures, methods of establishing crops, sowing and planting, density of stocking, severity of thinning, and investigation is urgently needed into the silvicultural characteristics of species, their demands on light, mineral food, depth of soil, their hardiness against fire, their root-systems, their degree of transpiration, their effect on the locality, especially in connection with re-fertilising taungya land and in converting "indaing" to bamboo forest, the age at which fertile seed is produced, vigour in production of coppice-shoots ; experiments in underplanting are wanted, and in the degree of admixture it is desirable to maintain in order to secure valuable species from insect and fungus plague ; exotics should be considered, and most important of all the varieties of natural regeneration should be tested and

the silvicultural systems suited to the various species and localities elaborated.

Some of the forests coming under the head of "commercially valuable" are undoubtedly richer than others, but the following sentence, culled from the 1909-10 Annual Report for Burma, may be considered in some respects typical of the *laissez-faire* policy adopted by the Forest Department towards those forests, to take in hand which may appear less obviously remunerative: "The majority of teak-bearing areas are under regular working-plans or girdling schemes, and the other areas, including fuel reserves and protective forests, do not, generally speaking, require working-plans at present." Compare with this Nisbet's dictum, "It is hardly possible for any large tract of woodland to be managed economically and for the productivity of the soil to be fully utilised, unless the management is regulated according to a working-plan," and Sir Herbert Maxwell, "The cardinal principle of forestry is continuity, secured by systematic rotation whereby, as in agriculture and horticulture, one crop prepares the way for the next, but its application demands longer foresight than is required in these kindred sciences, seeing that the rotation is measured not by seasons but by generations of men." In matters of forestry *everything* must be undertaken with a view to perpetuity; a working plan is necessary to secure continuity of action, though it must be elastic. Judeich sets forth that "The problem of systematic forest management is to arrange according to time and place the whole administration of a forest so as to attain in the highest possible degree the objects of management," and Schlich adds that "Continuity of action extending over a long period of time is an essential condition for successful forestry." The idea is too readily accepted that a working-plan is necessary only when exploitation is contemplated. In his plan for Biltmore, Gifford Pinchot places the "improvement in the present very mediocre condition of the forest" as one of his Three General Objects. The fact is that a working-plan or some temporary scheme of improvement should be drawn up for every Reserve by the Forest Officer who "settles" it, and work should be started thereon

as soon as the area is declared a Reserved Forest. We have referred to Judeich's definition of a working-plan as a scheme for arranging according to time and place the whole administration of a forest. Compare with this the "girdling scheme" in force in one division which lays down the exploitation correctly enough according to time and place, but which leaves to the girdling officer the selection of "an area to be operated on by supplementary improvement fellings in favour of promising young teak." It were better to allow no exploitation at all than to justify it by such vague and delusory measures for the maintenance of the growth.

Enough has been said to indicate the desirability of extending working-plans at a speedier rate than the Local Government at present contemplates, and the hint may be offered that revision of existing working-plans should be simultaneous for as large an area as possible and at least for a division. This enables certain forests to be held over till their timber is mature, while other working circles with a surplus of big timber can be more heavily worked. Vagaries in supply can be diminished if not avoided. It follows that a scheme should be compiled showing the year in which each working circle is to have its plan revised.

The preparation of schemes of improvement for small and detached reserves as well as for the less valuable forests in place of, or at any rate previous to, the usual scheme of exploitation is a reform really necessary. It is time for a provincial crusade against the Micawber notion of economy as manifested in practice, and for a revolt in favour of a sounder spirit insisting upon the replacement with at least equally vigorous growing stock of such active capital as may be withdrawn from the standing timber.

There is some foundation for the criticism brought against the Forest Department in Burma that it considers its wealth to lie in the richness of the existing teak forests, disregarding Adam Smith's principle that "Work is the origin of all values."

"Industries to be in a healthy condition must be conducted on financial principles" (Schlich), and in Burma enough security has not been taken to ensure the maintenance of the active capital represented by the total volume of the green teak standing in the

forests; this capital is being reduced, and such reduction, while justifiable, is accompanied by a rising volume increment per cent, will, in the present case, lead to a diminished annual volume increment, an anticipation which it is impossible to contemplate without misgiving. The rate of extraction should be determined by the rate at which the increment of the forest is stimulated.

"Eine alte, goldene Regel sagt, dass man nicht eher an demselben Orte einen neuen Schlag anlegen solle, bis nicht der zuletzt gefuehrte sicher in Bestand gebracht, *d. h.* bis auf ihm nicht die Kultur vollstaendig gelungen sei." (Judeich.)

To this we may add a quotation from the Dictum de Kenilworth, Henry III., Cap. XIX of 1266 and 1267, as showing that a sound economic basis for the management of forests is no vain imagining of recent years: "Woods may not be sold nor wasted by them that hold them now in any wise, but if it be for not keeping the last Term of Payment, notwithstanding they to whom the lands were given by the King, shall have necessaries for the keeping or separation of the houses and otherwise doing they shall be grievously punished." Finally Schlich's is no doubtful voice on this point, "The increment alone renders the growing stock an active capital; it replaces year by year that quantity of the growing stock which has been removed by fellings. Hence, it must be the forester's first care to bring the increment up to its normal amount."

In view of the tendency towards consolidation of blocks of forest to facilitate extraction and supervision, there appears some danger of Judeich's great principle for determining the systematic management of forests being neglected. As its soundness has never been seriously disputed, a word of admonition to the authors of working-plans in Burma may be not out of place: "Immer ist im Auge zu behalten, dass ein Wald mit jaehrlichem Nachhaltsbetriebe zusammengesetzt ist aus einzelnen Bestaenden oder Bestandsgruppen, die fuer sich betrachtet im aussetzenden Betriebe bewirtschaftet werden." "Aeltere Methoden der Ertragsbestimmung modifizierten den aus dem Ganzen entwickelten Hiebssatz durch die Ruecksichten auf den einzelnen Bestand. Wir

wollen das Umgekehrte, naemlich Modifikation der Bestandwirtschaft bez. Bestandskomplexwirtschaft und des aus ihr folgenden Hiebssatzes durch Ruecksichten auf das Ganze."

The problem the Forest Department in Burma has to solve is the evolution of some system of regenerating the forests by natural means so as to increase the proportion of timber, and to produce an approximately even-aged crop. The solution of this problem is to be found only by experimental research.

The greatest silviculturist alive, Professor H. Mayr* of Munich, has stated, that "It is only in the case of trees which grow quicker or at least as quickly as their neighbours that individual mixing is possible. In other cases planting in groups is preferable, so that perpetual supervision and continued felling in the experimental areas may not be required." He has also said with special reference to India that the artificial formation of pure plantations up to 500 acres each in area appeared to him a desirable step. But Gayer's caution against immoderate extension of pure forests may well be quoted here: "We may say in general that the leading principle in the rational economic treatment of woods must be less in the direction of pure than of mixed crops, and that the degree to which and the manner in which mixed forests occur throughout any system of management must be considered as the best test and standard by which one can estimate the knowledge and the capacity of those to whom are entrusted the duties of obtaining the best possible results from any given conditions of soil and situation"; while Schlich's remark, "If a competent manager is not available, pure woods may be preferable" affords food for thought to those concerned with the competency of the managers of the Burma forests.

Sufficient attention is not paid to the selection of the particular silvicultural system to be adopted in a Reserve, nor to the relation of the different systems to the varying localities found in Burma. Experimental work in silvicultural systems is altogether lacking.

* Since this was written we regret to say that we have received the sad news of the death of Professor Mayr.—[HON ED.]

We know from the researches of A. W. F. Schimper that the general type of vegetation present in a country is determined by the atmospheric precipitation, that the general type of the flora is determined chiefly by heat, and the details only by edaphic influence. More work in classifying the various zones of vegetation thus distinguishable may perhaps be expected from the Forest Department, thus paving the way for a more systematic knowledge of the congeners suitable for admixture with existing timber trees. Brandis' observation that in the tropics "successful forests occur only where the rainfall exceeds 40 inches, and that a luxuriant rich vegetation is limited to zones where the annual rainfall is much greater" shows the use that may be made of meteorological statistics by a fully informed Department.

In general, statistics are badly wanting; yield tables and volume tables; figures about cost of extraction, felling, dragging, etc., are hard to obtain in detail, although rough averages are easily ascertained. The particular operation in extraction where improvement is much required, is the transport of the log from the felling site to the floating stream or cart road; but there is apparently no literature on this problem. It is doubtful again whether traders are sufficiently encouraged to develop markets for heavy timbers.

There appears to be difficulty everywhere in obtaining labour for forest work. Intimately connected with this trouble is the absence of working-plans. Judeich tells us "An adequate labour-supply can be maintained only if the demand for labour is rendered as steady and regular as possible." There is no attempt made at recording sources of labour or names of useful foremen. Were the supply of labour treated as a separate heading for special report in Reserve Journals and in Annual Reports, a new Divisional Officer would be much less in the hands of his subordinates than he generally finds himself now. Such reports as well as affording the information noted above should show progress made towards the evolution of a regular and trained supply of labour with efficient foremen, the aim held in view being to employ local labour as much as possible and to give out work on contract in preference to departmental execution with labourers paid by time. The general

administration should pay more attention to local and to rural industries with a view to maintaining a settled industrial population. At present industry tends to be concentrated in the large towns.

MINOR FORESTS TO BE MANAGED IN THE INTERESTS OF THE LOCAL POPULATION.

Forests intended to supply timber, fuel, and fodder for local consumption, are to be managed by the orders of the Government of India, firstly, so as to ensure their preservation, and secondly, to afford a convenient supply of the desired produce. Such forests are beginning to increase in numbers, and bearing in mind the policy outlined above, it is time the Forest Department in Burma paid more attention to local supply. There are Reserves in Burma which have been under the control of the Forest Department for thirty years in which no form of professional exploitation or organised improvement has taken place. It is neglect of this kind which has caused the undoubted dislike of the Department felt by the mass of the people. "The proceedings and regulations of the Forest Department desirable as they may be from a financial and agricultural point of view, have provoked very great irritation in many parts of India. People who have been accustomed from time immemorial to pick up sticks and graze their cattle on forest lands, cannot understand why they should now be forbidden to do so, nor can they realise the necessity for preserving the trees from the chance of being destroyed by fire, a risk to which they were frequently exposed from the native custom of making use of their shelter while cooking, and of burning the undergrowth to enrich the grazing." (Lord Roberts.) Ribbentrop is no less explicit: "Forest protection has caused more ill-feeling and misunderstanding than any other part of the Forest Administration. On the one side the over-zealous Forest Officer, who from the day the forest was made over to his charge, wished at once to protect with strictness; and, on the other hand, the sometimes over-sentimental civilian, desirous of being the father of his people." In the face of this evidence it is folly to neglect the unpopularity of the Department. Steps should be taken in accordance with the

orders of the Government of India to do what is possible by means of convenient depôts, by fostering rural industries, by the grant of produce on easy terms, and by all possible relaxations in the case of this class of forest to render less unpalatable measures which will be as unpopular as is invariably the case when the interests of the present occupiers of the soil have to be subordinated to those of succeeding generations. Schlich tells us that "For domestic firing, India requires to maintain enormous areas under wood which will be almost doubled, if the annual requirements for construction, boat-building, tools, agricultural implements, public works, railways, etc., are added."

The British system of education in India has not been found a uniform success to say the least of it; "new employments can only divert a fraction from their traditional occupation, and Indian industries to succeed on a sufficient scale must still be chiefly rural." (Rees.) Here is a hint to policy-framers, the application of which is too big and too difficult a problem to be dealt with here. But in the introduction of any scheme for the encouragement of rural industries, it must never be forgotten that "The people of India are intensely conservative and wedded, to an extent difficult for Europeans to understand, to every ancient custom, and between their customs and their religion no line of distinction can be drawn." (Strachey.)

Forests classed under the fourth head of the Government of India, Pasture Lands notified as Reserves to obtain settlement of rights, are so few in Burma as not to demand special comment.

Throughout the Province there is a marked absence of co-ordination in the various branches of forestry. One circle has its own way of making roads, bungalows, or carrying out improvement fellings, thinnings, demarcation, etc., and another circle has a different way. The result of this absence of method is a rather pitiful independence flaunted by some divisional officers, who wandering vaguely among nebulæ pride themselves on their pet plan for a rest-house or on their skilful way of distributing the different kinds of work in improvement fellings instead of putting

their knowledge into the common stock and thereby acquiring a definition of ideal as well as helping others.

Let there be more *schemes*,—correlated in a logical sequence to form a comprehensive whole,—provincial schemes, well thought out and not hurriedly submitted in response to orders from above,—schemes for effecting progress and improvement in all the different branches of forestry, and let them be *elastic*.

The present hand-to-mouth method of expenditure seems to be a legacy from the days before the Department was united under a single professional chief, and one must add that its continuance is not sensibly threatened so long as control over the details of expenditure is exercised by a non-professional Secretary.

Until the head of the Department can be assured of some guarantee what he may be able to spend under a particular branch of expenditure four and five years ahead, the preparation of provincial schemes will not be enthusiastically welcomed by him. These schemes take some years to prepare if they are to be of any real use; they then have to be explained to a layman who has possibly never been off the beaten track inside a reserved forest in his life, and whose appreciation of silviculture may be indicated by his usual inability to distinguish between a Teak and an In tree. Such a man has to be convinced of the advantages of increasing expenditure on roads and buildings, and of the need for more research and study in silviculture; this explanation takes time, and may extend to details which every forester learns in his unrsery. Finally perhaps sanction is accorded, and after one year the whole scheme is shelved because of a fall in opium revenue or because of a famine. This gives some idea of the reasons for the absence of a properly centralised bureau of provincial schemes; and until the professional head of the Department can obtain guarantees for his branches of expenditure some years in advance, the hand-to-mouth method appears likely to flourish.

Now let us test the financial management of the Burma forests. Taking 1909-10, the latest figures available show annual expenditure 37 lakhs. We have to consider what rate of interest to apply to State Forest Management in Burma; assuming 3 per

cent, the capital necessary to run the concern is $\frac{37}{\cdot 03}$ or 1,233 lakhs; assuming 4 per cent, the capital is 925 lakhs. (Incidentally it may be remarked that these figures are not far off the total capital value of the reserved forests of Burma.)

Now what rate per cent is the forest yielding?

Let $x$ be the rate.

Then annual revenue being 91 lakhs, and expenditure 37 lakhs:

$$91 - 37 = \frac{x-3}{100} \times 1233,$$

$$\text{or} \quad 91 - 37 = \frac{x-4}{100} \times 925,$$

whence $x = 7{\cdot}4$

$x = 9{\cdot}8$

showing that the Burma forests are working at a very fair return on the capital invested, the profit being in the first case $7{\cdot}4 - 3 = 4{\cdot}4$ per cent and in the second case $9{\cdot}8 - 4 = 5{\cdot}8$ per cent.

The steps most needed in Burma to admit of a rational progress in Forest Administration are:—

1. The establishment of an experimental Forest Garden 500 to 2,000 acres in area, perhaps near Pyinmana.
2. An attempt at basing the amount of timber extracted annually from the forests upon the total amount that grows therein during the year.
3. *Provincial schemes* for roads, preservation of forests in catchment areas, restriction of taungya cultivation, improvement in Reserves at present not under working-plans, extension of working-plans.
4. Creation of an untrained staff to assist in forest engineering, extraction of timber, and collection of revenue.

## WITHANIA SOMNIFERA.

Recently I noticed that *Withania Somnifera* (Asgundh, vernacular), a plant of the genus *Solanaceæ*, was largely cultivated near Manasa, Indore State, some 20 miles from Neemuch. This shrub is apparently indigenous here, for I have noticed it growing near Indore in waste land, but having never seen it as a field crop

before, I made some enquiries concerning its cultivation at Manasa.

I am told that it is only within the past 15 years that it has been sown and that an area of over 400 acres is now occupied by the plant. It thrives well as a dry crop in comparatively poor soil and requires no manuring and is grown from seed which is obtainable in the local bazars.

The seed is sown in June and the crop is ready for harvest in April. Cattle do not eat the leaves which are supposed to have narcotic properties, it is at times much damaged by insects if the rainfall is deficient.

The root appears to be its chief product being largely employed in native medicine and is said to contain starch and to be used by Dhobies whilst the bright red seeds which are enclosed in bracts will coagulate milk.

The average expenditure per acre on Asgundh cultivation works out to Rs. 11, including land assessment Rs. 2 per acre and the nett profit is estimated at Rs. 4 per acre.

The commodity finds a ready sale and a good market in Bombay and Ahmedabad. I have no doubt the plant must be well known, but as I can find little information about it in Watt's Economic Products and none in any of my other books, it is possible that this note may be of interest. Apparently according to Watt the root of a species of *Ipomœa* is sometimes sold in the bazar under the same name "Asgundh." We intend trying the experiment of sowing seed of "Asgundh" with "Anjan" in the rains as a nurse.

W. F. BISCOE.

INDORE, C. I.:
*2nd May* 1911.

## IMMUNITY OF ANIMALS TO SNAKE-BITE.

In our last number we printed an article from the *Indian Field* on the above subject. As it is no doubt one of considerable interest to our readers, we reproduce two letters written to the *Indian Field* under the initials A. H. E. M.

SIR,—I have read with interest the article in the *Indian Field* of the 30th instant, on the subject of the "Immunity of Animals to Snake-bite." But I was much surprised by the statement that the mongoose is completely immune to the effects of snake venom.

If he be immune, why should the mongoose occasionally show fear of a cobra and always, as I believe to be the case, display great activity in avoiding a bite?

The writer of your article does not give the name of the French investigator by whom this is said to have been proved. Professor Calmette, perhaps the greatest French authority on snake poisons, arrived at a different conclusion. He found that eight times the dose of venom sufficient to kill a rabbit proved fatal to a mongoose in twelve hours; and, as the result of his experiments concludes: "The mongoose is able to bear without discomfort very considerable doses relative to its size, but its immunity is not absolute. If it generally triumphs in its struggles with venomous snakes, it is chiefly due to the extreme agility with which it is endowed." It is not quite clear whether these experiments were made with the poison of the cobra or with that of the West Indian "fer-de-lance" (*Trigonocephalus*); apparently the latter.

Again Fleet-Surgeon P. W. Bassett-Smith, writing in the *Encyclopædia Medica* in 1902, remarks: "The mongoose is remarkably resistant to cobra poison, requiring from 10 to 25 times as much venom per kilo, as a rabbit, to produce lethal effects."

It is obvious then that a mongoose's chances of life, once he is bitten, while greater than a rabbit's, yet depend on the quantity of venom injected being less than a fatal dose for him. It may be of interest to consider whether the amount of poison injected by a bite from an average cobra under normal conditions would be less or more than enough for a mongoose.

Now the minimum lethal dose of cobra poison for a rabbit is, according to the late Major Lamb, I.M.S., ·35 milligrammes per kilogramme of the animal's weight. Taking the highest estimate of the dose for a mongoose, 25 times the above is 8·75 milligrammes per kilo. If a mongoose weighs 2 kilos, which I doubt, it

follows that 20 milligrammes would be more than a fatal dose Now a medium-sized cobra will (again according to Lamb) yield about 200 milligrammes of venom, while the fatal dose for an average man is calculated at about 50 milligrammes. We have too good reasons to know that the latter dose and more is frequently injected, and it is probable that a healthy cobra can, on occasion, inject the whole contents of its poison gland at a single effort. It is therefore obvious that the danger to a mongoose attacking a cobra of receiving a fatal bite, if fairly struck, is considerable.

It appears then that the undoubted anti-toxic qualities existing in the blood of the mongoose are not of themselves sufficient to secure immunity.

Bassett-Smith writes: "Elliott believes that the success of this animal in fighting cobras depends on (1) its great agility, (2) its habits of setting up its fur, thus deluding the snake as to its vulnerable part. Its immunity is due to the habit it has of seizing the snake by the head, and often by so doing incising the poison-gland with its sharp teeth, causing the venom to escape and be swallowed by the mongoose; this would also reduce the possible amount to be injected down the fang. Then there is the inoculation of minute quantities of venom from repeated but ineffectual scratch bites. In these ways a partial immunity, which is hereditary, is established, becoming lost in time if the animals be removed to countries where cobras do not exist."

This theory is a plausible one. But there is a stumbling-block. It is not difficult to imagine a mongoose, by reason of his agility and increasing experience, surviving a number of encounters at the cost of a few scratches which the antidote in his blood has prevented proving fatal. These successive inoculations together with the poison swallowed at times would tend to increase his immunity so that an old individual might take a good deal more killing than a comparative youngster.

But can this additional immunity acquired from inoculation be transmitted to the animal's offspring? It is the old question of the heritability of accidentally acquired characters, often affirmed but never proved. Possibly the mongoose may eventually furnish

the evidence that has hitherto been sought in vain. (I offer this suggestion gratis to any advocates of the theory who may be on the look-out for new lines of investigation. It should be simple enough. Start a mongoose stud and inoculate each generation up to the limit : in course of time, if your breed be a good one, you should be in a position to supply all the laboratories in the country with anti-venine !)

It may be that the fact of the immunising factor being an anti-toxin in the blood, places it in a different category from other acquired characters, as it would seem possible for the embryo to be inoculated before birth from the anti-toxin in its mother's blood. If so, it is sure to be a well known fact and I have, in the valour of my ignorance, been merely tilting at wind-mills. I must take my chance of that !

If this is not the case, however, and we decline, in the absence of satisfactory proof, to believe that acquired characters can be inherited, it follows that we are in entire ignorance as to how the mongoose's existing inherited partial immunity originated; though it has doubtless been strengthened in some measure by centuries of natural selection. From this the further conclusion may be drawn that this inherited immunity probably—almost certainly—differs in its nature from such additional immunity as the individual animal may acquire from inoculation during its lifetime.

This conclusion is found to be of value when considered in relation to an important fact which I have not yet mentioned : I mean the fact of the highly specific character of snake venoms which appears to have been established beyond question by the most recent investigations, alike in India, Australia, and America, the result of which is that an anti-toxin obtained from the poison of the cobra, for instance, is absolutely ineffective as a curative against the poison of krait or daboia—Calmette's original belief to the contrary notwithstanding.

Hence it is to be deduced that any immunity which the Indian mongoose may acquire from inoculation with the venoms of Indian snakes will afford it no protection against the bites of distinct species from other parts of the world. But it may be the

case that the *inherited* immunity of whose origin we are ignorant does possess a more general protective power.

I am under the impression, which may be mistaken, that the venom of *Trigonocephalus* is relatively less deadly than that of the Indian cobra. If so, it is of interest in this connection to note that Professor Calmette's experiments appear to indicate a lessened degree of immunity in respect of the former species.

As to whether, or how far, the Indian mongoose is, in point of act, protected against venomous snakes other than Indian, I have no knowledge. He may be quite unaffected by a dose of 10 to 15 milligrammes of cobra poison or of 3 or 4 milligrammes of the krait's deadlier prescription; but personally I should hesitate to back his chances against a proportionate injection of the venom of, say, the Australian tiger-snake or the rattle-snake.

If, however, the mongoose's inherited immunity is found to be at all general, as the article in your paper implies, the theory is at once shown to be impossible, that it was originally due to the effect of inoculations through successive generations with the venoms of such snakes as inhabit the same countries. Unless, of course, the father of all serpents inoculated the father of all mongooses with a venom containing all the characteristics of all the various specialised snake-venoms now in existence!

I have written a longer screed than I had intended, but the subject is one of such interest that I hope you may be able to find space for it. Can any of your readers give evidence as to the suggested immunity of the *Felidæ?* or from personal experiences on the subject generally?

I may mention that the quotations I have made from Calmette and Bassett-Smith are taken from the Journal of the Bombay Natural History Society, Vol. XI, p. 116, and Vol. XV, p. 115. Major Lamb's figures are from articles in Vol. XIV, p. 221, and Vol. XVII, p. 16.

DWARKA, KATHIAWAR: A. H. E. M.
*30th April* 1911.

SIR,—*In continuation of my previous letter on the "Immunity* of Animals to Snake-bite," I should be obliged if you would kindly

add the following note:—"With regard to the Felidæ, it may be worth while adding that since first writing I have found that Mervyn-Smith in 'Sport and Adventures in the Indian Jungle,' page 104, states that native tiger slayers in Chota Nagpur poison their arrows with cobra venom and set them in traps to be sprung. When wounded the tigers go off and soon die, their movements being watched by the hunters."

A.H.E.M.

## FORESTS' PRESERVATION.

The preservation of forests is one thing for which the much maligned Government of India is given due praise and credit. Forestry is continually before us in the form of a highly efficient department, before whose rangers the wiliest coolie on the twig-hunt trembles. Every patch of Indian forest is carefully cherished and fostered, and every tree is subjected to a series of experiments to decide its uses for mankind. It has been no easy matter to restrain the wasteful disregard of tree life in large tracts of forest, and it has been specially hard to save these trees which are useful for timber and fuel, particularly as the advance of civilisation requires them, railways, buildings, charcoal-burners are leagued against the forest, and it needed a powerful hand on the other side to break the league. Such a hand has been ready, and the forests of India have been saved. It is a matter for local pride that in the coming years India need not apprehend the arid, treeless fate that has been predicted for the pine-clad plains of Russia, and the spruce bearing slopes of North America. But the zeal for the good of mankind goes too far, and we experiment too much with foreign trees. All that can be expected of India is that her forests should suffice for herself. She cannot, like the huge continents of the North, provide timber for the world at large, and it should be remembered that the trees of the country are suited to the climate, which ameliorate weather conditions, which can be easily and cheaply grown, are the trees which are best for the country. [*Indian Planters' Gazette.*]

## SCOTS FORESTRY COMMITTEE.

The Secretary for Scotland has appointed a committee to report on a suitable site for a demonstration forest area in Scotland and other measures which might promote sylviculture in the country.

The committee consists of Sir John Stirling-Maxwell, Bart. (Chairman), Lord Lovat, Mr. R. C. Munro-Ferguson, M.P., Mr. John D. Sutherland (Oban), Sir John Fleming, LL.D., Sir Matthew Wallace, and Mr. R. H. N. Sellar, Vice-Convener of Aberdeenshire. Mr. H. Warre Cornish, Dover House, Whitehall, S.W., will act as Secretary.—[*Daily Mail.*]

## A CHANCE FOR SPORTSMEN.

We print below an extract from the last Bengal Forest Annual Report. At a time when prospects of any decent sport are becoming annually more difficult to obtain, the Sunderbans would appear to offer attractions of a somewhat unique character and if sportsman and tiger met face to face on the former's *machan* at night no one could say that the tiger had not had a fair chance or that the sportsman had failed to get the value of his license fee. We would suggest to would-be sportsmen that here is their opportunity.

"Man-eating tigers were more aggressive in the Sunderbans this year than they have ever been known to be previously, though only 106 men were killed this year as compared with 103 in the previous year. An alarming feature in two different coupes was the climbing by tigers into sleeping shelters built on *machans* and the seizure of one of the inmates on each occasion. The further development of this new propensity, however, was fortunately arrested, as both these tigers succumbed to the temptation of traps in which they were caught and shot. This aggressiveness is attributed to the fact that enormous numbers of deer were killed or drowned in the storm-wave which accompanied the cyclone of October last, which upset the balance between tigers and their natural prey, and induced them to attack men. In the Singhbhum Division thirteen persons were reported to have been killed by tigers in the forests, one man-eating tiger was trapped, and five others shot by an army officer."

## THE FOREST SERVICE.

The democratization of Indian services is a process to be deplored, not upon abstract grounds, but for the very real reason that India is animated by an aristocratic spirit, and likes its rulers to be men of birth and breeding. India has gained nothing by the abolition of Haileybury as a training college for Civil Servants and it remains to be seen whether she has not suffered loss by the abolition of Cooper's Hill. The skill and science of future engineers and forest officers is important, but it is no less necessary that they should uphold the prestige of England in the eyes of Indians. The Forest Service was treated more tenderly than the P. W. D. on the abolition of Cooper's Hill, as the probationers were sent to a resident university. Now, according to the new regulations, any university which possesses a Forest School shall be permitted to train probationers for the Indian service. It is strange that the authorities cannot grasp the fundamental difference between a resident and a non-resident university. One trains the man in all respects; the other only trains a special part of his intellect. The non-residential system has done much harm in India and both Mussalmans and Hindus have realised this fact and are striving on their own initiative to improve matters. Yet the India Office or the Government of India, whichever it may be, sets them the bad example of putting a premium on mere brain and a discount upon education in other respects. The happiness of India, under British rule, depends largely on the *personnel* of the official staff, and Indian subjects are ill-content with a ruler who is a specialist in some science if in other respects he does not possess the qualities traditionally associated with their conception of a *pucca* sahib.—[*Civil and Military Gazette.*]

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## PAPER FROM TREES.

Some years ago M. Marcel Magnan published in the *Revue de Paris* his investigations into the consumption of wood for paper. He then found that it equalled 4 milliards of kilogrammes. In the following year it had doubled, and at that M. Magnan left

the matter. Almost all this paper is made either mechanically or by chemical process, the first being used for newspaper and the other class for books. A pine of forty years' growth only produces 150 kilogrammes of pulp, and the production of 1898 represented some 7,300,000 trees, covering about 600,000 hectares. It may be mentioned that a milliard is equal to a thousand millions, a kilogramme is 2⅛lb., and a hectare is 2 square acres. Sweden, we learn, *supplied half the pulp paper of last year's production, and in* 70 years, we are told, Swedish forests will have disappeared. During the last election France required 845,535 kilogrammes of paper for bills alone. A process has been discovered of getting paper from old tar, yarn or rope. Another suggestion is to make paper from the bamboos, the mulberry, the furze bush, and the sugarcane. In the French Congo and Soudan, there is an abundance of papyrus which lends itself to paper-making.—[*Commerce.*]

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## SUITABILITY OF VARIOUS WOODS, BAMBOOS AND GRASSES FOR PAPER-MAKING.

We mentioned in a previous issue that Mr. Raitt had been deputed to the Research Institute at Dehra Dun to test the suitability of various materials for paper pulp. Below we print a memorandum drawn up by Mr. Raitt which contains definite instructions for the selection and collection of materials. This memorandum has, we understand, been circulated to Local Governments by the Government of India.

### COPY OF A MEMORANDUM DRAWN UP BY MR. RAITT.

*Paper Fibre Testing at the Forest Research Institute.*

1. It is recommended that before selecting and collecting any material proposed, enquiry be first made of the President, Imperial Forest Research Institute and College, as to whether such material has already been tested, or if samples of it are already available in the Institute.

2. Samples should be accompanied by a memo. giving the scientific and local name and place of origin.

3. *Woods*—

(*a*) Trees of rare occurrence are not admissible nor those of which the average girth is under 2 ft.

(*b*) They should be fairly cylindrical and regular in outline so as to facilitate barking. Deeply fissured outlines in trees under 5 ft. girth are not suitable, but they may be passed if they exceed that measurement, as the larger bulk compensates for the additional cost of clearing bark out of fissures and crevices.

(*c*) Dry seasoned weight should not exceed 45 lbs. per c. ft. and preferably under 40.

(*d*) Samples should consist of cross-cut sections, with bark left on, of not less than 20 or more than 40 lbs. in weight. In the case of large trees the section may be split and a quarter or half of it sent.

(*e*) Samples of woods which remain sound during seasoning may be sent green. Those liable to rapid decomposition, and which do not season well in the log should be split into wedges and dried in the sun, or artificially before sending.

4. *Grasses*—

(*a*) Only those which are sufficiently gregarious to permit of cheap collection are suitable.

(*b*) Samples should preferably be cut just before or during flowering *and prior to formation of seed*. If cut after seed production, the fact should be stated on the accompanying memo. so that due allowance may be made for it.

(*c*) Samples should consist of the whole grass stem and leaf and should be well dried before packing—not less than 20 or more than 40 lbs. may be sent.

VOLUME XXXVII NUMBER 8.

# INDIAN FORESTER

*AUGUST, 1911.*

## THE RECRUITMENT OF THE IMPERIAL FOREST SERVICE.

Below we print the new rules which are to govern recruitment for our service. These have already appeared in the Indian Press, but as they are of exceptional interest to all readers of the *Indian Forester*, we have no hesitation in inserting them :—

I.—That any University which possesses a Forest School, approved by the Secretary of State, should be permitted to train Forest probationers. This shall have effect as regards probationers selected in and after 1912.

II.—That the Secretary of State should approve the Forest Schools existing at the Universities of Oxford, Cambridge and Edinburgh.

III.—That a course of training in practical forestry in Germany or elsewhere, a certain standard of knowledge in a vernacular, and any other special qualifications required by the Secretary of State in Council, should be imposed upon all probationers.

IV.—That the studies of the probationers should be controlled on behalf of the Secretary of State by the *Director of Indian Forest Studies (hereafter styled* the Director).

V.—That the Director should be a selected officer of the Indian Forest Service, should be paid such salary as the Secretary of State may determine, and should *hold office for a term of five years.*

VI.—That the duties of the Director should be—

(1) to arrange for and direct the training in practical forestry of the probationers, and to exercise supervision over them while so engaged ;

(2) to consult with all *Universities where there may* be Forest probationers as to the special studies to be undertaken by them, and as to the examinations or tests of proficiency to be required of them;

(3) to *give lectures, if so required by the Secretary of* State, in Indian forestry to Forest probationers at an approved Forest School.

VII.—That, in order to enable the Forest probationers who have been selected, or who *will in 1911 be selected, to* complete their training, the payments noted in the margin,* which are at present made for various purposes at *Oxford* by the Secretary of State, should continue to be made to the end of the Midsummer term, 1913, and from that date should be discontinued ; and that for such period the Director should give lectures in Indian forestry at Oxford to Forest probationers, and should discharge all other duties that are at present discharged by the Indian Professor of Forestry at that University, whose appointment should cease from the date of the

| | £ |
|---|---|
| * Grant for teaching Geology ... | 100 |
| Placed at the disposal of the Forest Delegacy for other purposes ... | 100 |
| Rent, rates, and taxes of house for teaching museum, etc. ... | 95 |
| Forest garden ... | 100 |

appointment of the Director. The post of Assistant Professor, now vacant by the death of Mr. Fisher should be abolished. If the officer in charge of the Oxford school up to Midsummer, 1913, reports that he requires assistance, this may be provided by the temporary deputation of a Forest Officer at home on leave, or otherwise, as may be convenient.

VIII.—That, for the purpose of reporting on the qualifications of candidates for appointment as Forest probationers, the Secretary of State should constitute in each year a Board of Enquiry.

That the Board should consist of—

(1) a representative of the Secretary of State;

(2) the Director;

(3) a person appointed by the Secretary of State who is not connected with the India Office;

(4) a person nominated from time to time by the Government of India.

IX.—That for the year 1911, the Board should select the probationers, provided that, should there be more candidates considered by them to be qualified in every respect than vacancies to be filled, the Secretary of State should reserve the right to require the candidates to pass a competitive examination conducted by the Civil Service Commissioners, on the result of which their final selection would depend.

X.—That while a preference should continue to be given to candidates having an Honours degree in some branch of Natural Science, for the present no injunction should be laid on the Board, in making selection among candidates so qualified, to give preference to holders of a forestry diploma.

XI.—That, whenever an examination is introduced, it should immediately follow the nomination of candidates by the Board, and should be a uniform examination for all candidates nominated.

XII.—That the Civil Service Commissioners should be consulted as to the scheme of an examination, and should be asked to suggest a syllabus and system of marking suitable for men holding various Honours degrees in science; chemistry and German, or French (as an alternative to German), being compulsory subjects.

XIII.—That the age-limit should be between 19 and 22 on the 1st January of the year in which the selection is made.

XIV.—That the ordinary period of the probationary course for all candidates should for the present be two years, *including seven months abroad.*

XV.—That the provisions of the existing regulations as to the probationers' allowances should be retained.

2. As regards the proposal to institute in India a course of training for the probationers, it is considered that there are practical difficulties which would make it impossible that the scheme for providing such a course should as yet be carried out, and the Secretary of State concurs in the view expressed by the Government of India that the proposal must in present circumstances be dropped. The Government of India recognise, however, that a period of training in India for about a year's duration is essential, mainly in order to give the new arrivals an opportunity for learning the vernacular, for gaining a general acquaintance with the conditions of working the local forests, and for acquainting themselves with the systems of forest and revenue laws and with the details of forest office work and accounts. For the guidance of Local Governments, therefore, the following general principles are indicated, the adoption of which the Government of India hope, will effect considerable improvement in the existing arrangements :—

(i) That during his first year of service in India, the young forest officer should be considered to be still under training, and that during this period he should not usually be utilised for the ordinary purposes of forest administration ;

(ii) that the training should be under a selected officer or officers;

(iii) that it should include both active work in a division, and a period of work at the headquarters of the Circle for the purposes mentioned above; and

(iv) that some arrangement should be made for officers under training to tour in their own provinces, and possibly for visits to selected forests in other provinces.

We hold the opinion that the new rules as printed above may not be a final solution of the recruitment question. They appear to be rather in the interests of British Schools of Forestry than of the Department in India; or, in other words, rather framed to encourage Universities at home to found or consolidate Chairs of Forestry than for the benefit of the Indian Public Service. This, however, is nothing new. The recruitment rules of the past cannot be said to have had as their main object the interests of India, ever since the Nancy training was done away with. From the late sixties our recruits were trained in France and Germany, and we have never heard it denied that the training was an eminently practical one which, in the interests of our Service, could not have been greatly improved upon. This continued till up to some twenty-five years ago. At that time prominence was given to the fact that the Cooper's Hill College was not paying its way; in other words, that as far as the Government of India were concerned, it was from a pecuniary point of view an asset on the wrong side. In order to bolster up Cooper's Hill, it was suddenly decided to initiate a Forestry training there, and the eminently practical Continental training which was supplying the needs of India with a marked degree of success was knocked on the head for the benefit, not of the Indian Forest Department, but of Cooper's Hill. This continued till somewhat lately, then vested interests at home became too strong for Cooper's Hill and it, as an Engineering College, was doomed, the Forestry Course there being doomed at the same time. This was not done, we infer, at the instance of the Government of India where the new departure, it is believed,

met with considerable opposition, but was due to outside pressure in England. A School of Forestry was then started at Oxford under the guidance of Sir William Schlich. It having been decided that our recruits were to go through their Forestry education at an University at home, this was perhaps the best scheme that could then have been devised. Owing to various influences this Oxford training is no longer to be essential and any University that can make some semblance of a show of being in a position to afford a Forestry education may train our recruits for us. The underlying principle seems to be, as we have pointed out, to encourage and give a stimulus to Forestry at home, and this is laudable in the extreme, but, as we have said, we are not inclined to think that this will be greatly to the benefit of India, nor do we consider that there is any great opening for Forestry in Great Britain. Just as Nancy was abolished to bolster up Cooper's Hill, so is an Oxford training held to be no longer necessary, in the interests, as it seems to us, of other schools of Forestry for which we can see little scope. We regard proposals to establish Scientific Forestry in Great Britain on an extensive scale as little better than still-born, we say so with regret. To inaugurate practical Forestry at home with any hope of commercial success, there must exist one of two conditions. Large proprietors must be induced to take up planting and conservation of already existing plantations on a very considerable scale. This they cannot, as a rule, at present do, largely owing to the excessive taxation placed upon land, and the decrease in the value of agricultural property. To enable them to succeed pecuniary inducement must be offered, such as State loans for long periods at very small or no interest, and exemption of all planted and forest lands from taxation. This procedure no Government is likely to agree to, and even if such inducements were offered, we doubt if proprietors would avail themselves of them. Moreover, owing to recent legislation large estates promise to be comparatively few in a short time. The alternative is that the State must buy out, compulsorily expropriating, if necessary, landed proprietors; that this will ever be done appears visionary in the extreme, as the requisite funds must come from the public

purse. With the ever-increasing demand for money on the part of the Army, the Navy, and various other public Departments, it seems in a high degree unlikely that any Government will set aside for Forestry large sums from which it will see no return for many years. No doubt to meet the wishes of its individual supporters it may enter in its budget inconsiderable and inadequate sums for planting and Forestry purposes, but it seems more than probable that ultimately these sums will, owing perhaps to some unforeseen and urgent demand, be diverted to some other channel. In other words, to please a small section of the public a Government at home may play with Forestry, but we have little expectation of seeing it taken up on a large and necessarily expensive scale. Much as we should like to see a Forest Department established in the British Isles, with Forestry Colleges that would be in a position to vie with the Continental ones, we confess that such an ideal is to us outside the range of practical politics, and we are reluctantly forced to the conclusion that it might conceivably be more in the interests of India if the small number of recruits annually required by us were trained together at a single centre, specially equipped with the object of supplying India with the best material available, trained in the best training grounds and under the best conditions.

The edict has, however, gone forth, and before it is altered, we have to give a trial to yet one more method of recruitment and training.

Passing now to the actual rules as they stand.

Rule I states that the Forest School of an University has to be approved by the Secretary of State, and Rule II adds that he approves Oxford, Cambridge and Edinburgh. This appears to us somewhat invidious and a leap in the dark in the event of Sir William Schlich leaving Oxford, as far as that University is concerned, probably also as far as the other two are concerned, since the success of a Forestry School must lie much in the hands of the incumbent of the Forestry Chair.* Incumbents of Chairs of Forestry

* Since the above was written we have heard that Sir William Schlich has been appointed to the Oxford Chair of Forestry for 3 years.—HON. ED.

and Lecturers in Forestry should, in our opinion, be men with a sound and practical experience of such, who would thus be able to embody in their instruction the results of their observations, and not be dependent on what they may cull from technical works or from a short course put in at some Forestry centre. In the interests of our Indian recruits, they should have had wide practical experience in sylviculture, in the carrying out and control of working plans and in forest administration generally, and a detailed knowledge of the constitution and requirements of the different types of forest in the various countries of Europe and the East, born of intimate acquaintance with such. All this, no doubt, Sir William Schlich has, but can we say the same for any of the incumbents of Forestry Chairs or Instructors in Forestry in the Schools of Great Britain with the exception perhaps of Glasgow, which, rather to our surprise, is not included among the approved schools?

Rule III imposes a course of Continental training. This is satisfactory as far as it goes, but we consider that the time spent on the Continent might well be longer and that at the University shorter. The next three rules deal with the appointment of a Director of Forest Studies. Such an appointment we regard of the highest importance and as a *sine quâ non.* We are entirely in sympathy with its object, but we think that the duties of the Director might be more definitely laid down. It is satisfactory to know that he must be a member or retired member of the Indian Forest Department. His duties should, in the first instance, comprise careful examination of the various courses of instruction at the various Universities and the status and conditions of the students attending these courses, in order to thoroughly satisfy himself that the course and the surroundings at an University thoroughly meet the needs of our Department in India. His opinion on this point should be accepted as final. He will no doubt have to personally conduct our probationers over the Continental Forests during the seven months of their Continental training, and for this purpose should be a good linguist, knowing well both French and German. At the end of the course he should examine the students before they are allowed to proceed to India and certify

as to their Forestry qualifications, those who are not passed by him being either altogether rejected or put back. His term of office is placed at five years; with this we agree, especially as these five years may presumably be extended.

We feel that this post is in every way a most responsible one, and should be held by a Senior, perhaps very Senior Officer, who has shown marked ability in India, and who realises how important it is to have men in the Indian Service not only of high professional qualifications but of good social standing.

We do not quite understand clause 3 of Rule VI. Does it presage that in future it may be found that an University training may be deemed unsuitable and that it may be necessary to establish either a Forest School for our Indian recruits or a National School of Forestry?

Rule VII appears to us fairly satisfactory, and to constitute a certain safeguard against the selection of undesirables: we should, however, have liked to see that the official nominated by the Government of India should be a Senior Administrative Officer or a recently retired Officer of the Forest Department.

Rules IX to XII deal with the selection and examination of nominated candidates. First of all as regards the selection we are against too great stress being laid on a Science degree, especially as it has lately been most wisely laid down, and this is being given effect to, that our Research Institute posts are not to be confined to members of the Department; in other words, that we are not to be dependent upon the Department for our Research Institute experts. Such a qualification is no doubt satisfactory, but there are others we consider as of equal importance. For example, we would prefer a boy of good social standing, of good general education, efficient in physical exercises, likely to eventually turn out a strong Officer in India, to a callow youth whose one object in life has been the possession of a Science degree, in which, perhaps, as has been too often the case, some subject, such as Geology, of restricted use to him in India, has taken a prominent place. We should like to see the Board given the largest discretion in selecting candidates. They will, no doubt, while

taking full cognizance of the value of a Science degree, also consider general educational and physical qualifications, and will doubtless correctly appreciate the standing of the centres or schools where these qualifications had been obtained, not forgetting that the social status of a candidate is of the highest importance in India, and has been at times neglected.

Following the preliminary selection, there might perhaps be held a competitive examination among nominated candidates, based on the lines of those in vogue for the various Civil Services, Army, etc., at which general proficiency in subjects taught at our public schools would be the test of success. French and German should be compulsory, or one or the other : if French, it should be recognised that the practical training should be in France ; if German, then in Germany. We would incidentally notice that this practical training should not be confined to planting a youth for some considerable length of time in a forest area not much larger than one of our ranges under a single Forest Officer, as has, we are informed, been at times the case in the past, but should consist of extended touring, so as to open the mind and afford a varied and practical acquaintance with Continental forests.

We are glad to see that the limit of age has been fixed under Rule XIII at 19 to 22 : this means that a boy would reach India at 23 perhaps on the average, which is quite old enough. We do not wish to see any more of our recruits reaching India at 26 or 28 years of age.

Next follow general principles for adoption by Local Governments with a view to affording recruits a general acquaintance with the Forestry conditions and the vernaculars of their province before they are to be utilised for the ordinary purposes of Forest administration. There can be no doubt that this expression of opinion on the part of the Government of India is distinctly a move in the right direction which might with advantage have been put into practice long ago. The methods adopted by various Local Administrations to give effect to this expression of opinion will be watched with great interest, especially as they have been allowed a free hand. It would be premature

to indicate exactly what measures might advantageously be adopted, every Government will have to work out its own salvation with the assistance of its Administrative Forest Officers. All we venture to say at present is that it is not clear how young recruits are to be further trained in the way that they should go, unless they are under some Officer specially deputed for the purpose, as Conservators and Divisional Officers have little spare time at their disposal; the suggestion is put forward that provinces where the Forestry conditions and the vernacular are somewhat similar might at time combine their recruits under one Officer, at any rate tentatively.

As time goes on, and until it is more fully realised how doubtful the possibilities of any State Forest policy in Great Britain on a large scale are, and as a consequence how small is the scope for any higher Forestry education at the Universities, this newly prescribed system of recruitment will probably remain in force, but as we have already indicated, is it somewhat premature to regard it as a permanent one.

The success of the scheme seems to us to depend to a very large extent on the personal equation of the Director of Forest Studies and the discretionary powers allowed him. With the right man the scheme is not to be condemned offhand, as the Indian training, added to the Continental training, appears not unlikely to make up for any shortcomings that may or may not be found in a training at one of the British Universities.

As the appointment of the Director appears to rest largely with the Government of India, there is every hope that the right man will be appointed and that he, knowing our Indian requirements, will satisfactorily do his best to give effect to these, thus affording the scheme a fair and possibly successful trial, and justifying the care that has evidently been exercised to overcome the difficulties in the way of successfully recruiting the Imperial Forest Department.*

* Since writing the above, we understand that Mr. A. M. F. Caccia has been appointed "Director of Indian Forest Studies." The scheme will thus be afforded a trial under excellent auspices. - HON. ED.

## THE RESOLUTIONS OF THE BOARD OF CONTROL, IMPERIAL FOREST COLLEGE, 1911.

We publish below the Resolutions of the Board of Control and the orders of the Government of India thereon :—

Resolution I we omit as in this is contained the names of students who gained the various certificates and the prize winners. These names have already been given in our May number.

RESOLUTIONS PASSED BY THE BOARD OF CONTROL OF THE IMPERIAL FOREST COLLEGE, DEHRA DUN, AT MEETINGS HELD ON THE 21ST, 22ND AND 27TH OF MARCH 1911.

*Resolution I.*

* * * * * * * * * * *

*Resolution II.*

The President brought to notice that in some instances Local Governments have deputed students to Dehra Dun with a promise that they shall receive three years' consecutive training to qualify for a direct appointment in the Provincial Service, and that it is not always possible to accept for the third year's training all the students who are nominated for it. This is clearly shown by the fact that in May 1910 applications were received for the admission of 23 students to the third year's course, the maximum number of students for that course being provisionally fixed at 15.

The Board consider that so long as the present system continues, power should be reserved to the President to allot the vacancies in the third year class at his discretion, as laid down in number 10 (*i*) of the present College rules. As, however, paragraph 6 of Circular No. 31-F.-166—4, dated 9th October 1906 imposes no restrictions on the guarantee of three years' consecutive training and as any intervening service in the Ranger class *ipso facto* debars a *direct* appointment to the Provincial Service, it is desirable that the position should be made clear to all Local Governments.

The Board also consider that a candidate provisionally selected for the Provincial Service and deputed for the three years'

course should not be allowed to undergo the third year's course (even if he has obtained the Higher Standard Certificate at the end of the two years' course) if the President considers him unfit to undergo the special course of training for appointment to the Provincial Service. In other words, that the President should have discretion to send back any student at the end of the two years' course even if the said student has been provisionally selected for direct appointment to the Provincial Service by the Local Government which deputed him to the College.

After discussing the matter it was resolved :—

(*a*) That owing to the number of vacancies for the third year's course being limited, and owing to the President of the College not being in a position to assign vacancies to a Local Government any considerable time in advance, as the class is not formed until the April—May prior to its assembling, Local Governments should refrain from guaranteeing direct appointments to provisionally selected candidates for the Provincial Service until the class has been formed, or should only do so on the President of the College informing them that he can take their candidates for three consecutive years.

(*b*) That the President should have power to refuse to admit to the third year course any candidate whom he considers unfit to undergo the special course of training for appointment to the Provincial Service.

### *Resolution III.*

During the last two years attempts have been made to induce students to make collections of economic products, *e.g.*, dyes, gums, fibres, etc., while on tour. These have been successful and it has been found that the collections cannot only be made without prejudice to ordinary work, but that by the fact of the students having to make these collections they gain very considerable practical knowledge of the minor forest products.

The President proposes to prescribe these collections annually and to assign marks as shown below for them :—

| *For*— | | *Substitute*— | |
|---|---|---|---|
| Utilisation— | | Utilisation— | |
| Periodical ... | ... 116 | Periodical ... | ... 100 |
| Final { Written ... | ... 117 | Final { Written ... | ... 100 |
| Final { Oral ... | ... 117 | Final { Oral ... | ... 100 |
| | | Collection of economic products ... | 50 |
| Total | ... 350 | Total | ... 350 |

The Board approve of the proposal.

They also consider that as Surveying and Engineering are at least equal in importance to Botany so far as Rangers are concerned, the number of marks obtainable in all three subjects should be equal. Also that marks allotted for the periodical and final examinations should be equal.* These opinions have been given effect to in the scale of marks included in the proposed new rules referred to in Resolution No. IV. The Board recommend them for the sanction of the Government of India.

*Resolution IV.*

In view of the probable early inauguration of a separate course for the candidates for the Provincial Service (direct appointment), it is resolved that—

(*a*) Separate rules for the constitution of, admission to, and regulation of—

(*i*) the proposed Provincial Service class,

(*ii*) the ordinary Ranger's course,

are required, and that the rules as proposed by the President of the College and as modified by the Board of Control be recommended for adoption.

(*b*) That the syllabus of instruction as detailed for Provincial Service class by the President of the College be similarly recommended for adoption.

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* Mr. Carter dissented. He prefers the present arrangements under which one-third of the total marks are given for the Periodical examination and two-thirds for the Final examination.

*Resolution V.*

In view of the fact that the same student frequently obtains most of the prizes given at the College, the Board consider that the following note should be added to the rules :—" No student who has been awarded a special prize for any subject will be awarded a medal for the same subject."

*Resolution VI.*

The President brought to notice that Mr. Rogers' Manual on Engineering is out of print, and that it is moreover not suitable for use as a text-book at the College. Inasmuch as the absence of a suitable text-book is severely felt, the Board consider that Mr. Rogers' Manual should be revised by an early date and a new edition issued. It should be very distinctly recognised that the revised manual is intended for the use of the College students and is not intended to be a book of reference for the Department at large; further, that in the event of it being difficult to find a suitable officer of the Indian Forest Department prepared to undertake the revision, there is no objection to this being undertaken by an officer outside the Department.

| | |
|---|---|
| F. B. BRYANT. | B. B. OSMASTON. |
| L. MERCER. | H. CARTER. |
| F. LODGE. | S. CARR. |

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Circular No. 14-F.—133-2.

FROM

H. B. HOLME, ESQ., I.C.S.,

*Under Secretary to the Government of India,*

TO

ALL LOCAL GOVERNMENTS

AND ADMINISTRATIONS.

*Dept. of Rev. & Agri. Forests. Simla, the 17th May* 1911.

SIR,

I AM directed to forward, for information and communication, to the* (Chief Conservator and) Conservators of Forests, copies of the resolutions passed by the Board of Control for the Imperial Forest College which met at Dehra Dun in March last

* To Burma and Central Provinces only.

and to communicate the following remarks and orders on the resolutions :—

*Resolution No. II* (*a*).—The orders contained in this Department's Circular No. 31F.—166-4, dated the 9th October 1906, impose no restrictions as to the number of candidates who may be selected by Local Governments for direct appointment to the Provincial Forest Service. In view, however, of the limited accommodation available at the College, the maximum number of students it is possible, under existing conditions, to admit to the third year's course in any year is fifteen. The Government of India agree, therefore, with the Board that a third year's course immediately after the conclusion of the second year's course, obviously cannot be guaranteed to all selected candidates, and Local Governments are requested to refrain from guaranteeing direct appointments after three years' consecutive training. In order, however, to provide for men, already selected for direct appointments by Local Governments, who cannot get a third year's course, the Government of India agree that as a special case, and pending the introduction of revised arrangements, a Local Government should be empowered to give a direct appointment as probationary Extra Assistant Conservator to any selected candidate, who, within two years of his obtaining the College Higher Standard Certificate, has not been able to complete a third year's course.

3. *Resolutions Nos. II* (*b*), *III*, *V and VI*.—The Government of India accept the recommendations contained in these resolutions.

4. *Resolution No. IV*.—This is under consideration and orders on it will be issued in due course.

*I have the honour to be,*

SIR,

Your most obedient servant,

H. B. HOLME,

*Under Secretary to the Government of India.*

Resolution II emphasises the point that Local Governments should not promise direct appointments to the Provincial Service, since they cannot be sure that the President of the College can take candidates for three consecutive years.

Moreover it is not to the interest of any Government to promise a candidate a three consecutive years course or even three years at Dehra until the result of the examinations after the two years' (Ranger's) course has been apparent. These examinations may possibly show that he is unfit for the Provincial Service. If the President of the College would guarantee to take a candidate for three consecutive years, the case might be different, but this naturally he is not probably in a position to do. The Resolution then goes on to propose that the President of the College should have power to refuse to take any candidate for the third year whom he considers unfitted to undergo the special course of training.

This Resolution is very much to the point and will make matters much clearer than they are at present, and it is satisfactory to see that the Government of India have approved it.

It is further laid down that in the event of the President not being able to take a man for the third year at once, he may, if provisionally selected for the Provincial Service, be appointed to it within two years of his gaining the Higher Standard Certificate. This also seems to be a step in the right direction, and the fact that an early appointment to the Provincial Service is not debarred owing to the President of the College not being in a position to give a candidate 3 consecutive years should act as an incentive to good men to come forward.

The second portion of the resolution giving the President power to refuse a third year candidate is also approved, though of course it may be accepted without question that this power will not be exercised unless there are strong reasons for it.

The Government of India have accepted both these proposals and have laid down that the full marks for the periodic examinations should be equal to those of the final examination, while a certain number of marks should in addition be given for collections. This seems satisfactory. Up to date the full marks for the final examinations have been generally two-thirds of the total, which is too high a figure, as students often become confused and nervous in their final examinations and do not do themselves justice.

It is also accepted that the value of the marks given for Engineering and Surveying, Drawing, etc., be not below the value of those given for Botany. This is advisable, since a good knowledge of Engineering and Surveying is generally of more use to a Ranger than of Botany.

In order to give effect to these orders alterations will have to be made in para. 6 of the College Calendar, such will no doubt be shortly sanctioned and circulated.

Omitting for a moment Resolution No. IV, we pass to Resolutions V and VI. These explain themselves. However satisfactory it may be for an exceptionally good student to annex prize after prize, there is a feeling that other good men should have a chance, and if the latter know that one man will not be permitted to annex most of the prizes, there will be greater competition and incentive to good work. As regards Mr. Rogers' Manual of Engineering, this is excellent in many ways and reflects every credit on its compiler, still it is in places too advanced for the Rangre's class, *e.g.*, the students of this class do not know and are not taught trigonometry, while the Manual contains references to such. Thus a more concise and simple Manual based on that compiled by Mr. Rogers is a great desideratum, and if no Forest Officer can be found with time to prepare it, it may well be entrusted to an expert outside the Department. We are glad to see that these Resolutions have been accepted, though it is probable that the preparation of a new Manual may be at present deferred till the issue of that being prepared by Mr. Percival, which may or may not meet the College requirements.

Reverting to Resolution No. IV. It is not so much the Resolution as the ground that gave rise to it that is important. Here, apparently, is clearly foreshadowed the intention of the Government of India to inaugurate a separate training for the Provincial Service direct candidates. This we have been pressing for the past two or three years, as we regard it as essential in the interests of the Service. When it has been sanctioned, as we have no reasonable doubt that it must be, it will then be time to discuss the rules for admission to that course and the detailed syllabus of instruction.

We expect that the next meeting of the Board of Control will be an important one, since it appears not unlikely that a separate course for the education of Provincial Service candidates will by then have been sanctioned, the details of which will have to be closely scrutinised, and possibly further proposals in connection with it resolved upon and submitted to the Government of India for orders.

## THE NEW BURMA FOREST SCHOOL AT PYINMANA.

The Burma Forest School is to be moved from Tharrawaddy to Pyinmana at the end of this year and the course for Rangers is to be changed from Burmese to English. These are considerable changes and they may—it is to be hoped they will—lead to still greater changes, for it is not too much to hope that the present may be made a turning point in forestry in Burma. It may be said, without fear of offending any of those who have been in charge, that the school for a number of years after its opening suffered from two defects—admission of insufficiently educated subordinates and a superfluity of theory. These are the two great faults we want to avoid now. The question of the desirability of supplying and training good jungle men as Rangers need hardly be discussed, as for many years to come the outturn of good solid forest work in any division will be regulated by the quality of the Rangers. The question of the supply of the exact kind of Burman required for Ranger is a difficult one, more difficult than in India, because in the latter country conveniences of all kinds are more readily obtainable, hardships are fewer, and the expenses of the Ranger, such as living and schooling for his children, are much less. In Burma we can look to two classes for Rangers, one being composed of the sons of merchants and Government officials, youths who have lived most of their lives in towns, and the other the better educated men in large villages and country districts. Unfortunately the supply of the latter is insufficient, mostly owing to lack of education, and the want of these men is the more felt because they are often cut out for forest officers and when they

do manage to learn enough to become good subordinates, they can hardly be surpassed. Cases will occur to most men who have served in Burma. Probably however the majority of Rangers now serving have been recruited from the town class and a great deal depends on the proper selection of these men. They often join the department in the hope of a comfortable Revenue Collector's billet, but they may be induced to take an interest in forestry by judicious treatment and can in time be made reliable officers. A sufficiency of brains is required, a good character and good health. The men to be trained should be recruited from these two classes with great care, as a rule after several years' work in the department. The needy half-educated clerk will be attracted by the pay, lately fixed on a generous scale, but a hard course of improvement fellings or weedings in the rains will probably dispose of him. Now and again a promising recruit may be picked up by the Divisional Officer on tour, but the absence of knowledge of even simple arithmetic is usually a check, and it is disappointing to find how seldom the man, who promises to go and learn enough to go to the school, attempts to do so.

Having got a good Burman it is essential to treat him well at the school, and to give him enough pay to allow him to send money to his wife or parents. Even more important is it to get the right kind of man to teach him and run the school, and the only kind of man who can do this is one of long experience of the country, who thoroughly understands and is in sympathy with the Burman. We cannot expect unvarying regularity and decorous behaviour from a Burman on all occasions, but when he has got a "thakin" who will go out and walk with him everywhere and explain everything to him on the spot, in his own language when necessary, without a lot of unnecessary formalities and note-taking, we are in a fair way to turn out nine good Rangers out of every ten students. However much the course may be English, it is certain that a Burmese sentence will be invaluable now and again and the students will certainly in many cases prefer to answer in their own language. It may be said that this should be absolutely discouraged, but the freedom of uptake and flow of thought will

certainly not be so generous when English is always rigorously enforced, and to some of the men it will be a matter of hammering in a strange subject in a foreign language. By all means have the lectures and the main part of the talking in English but let us have a leaven of Burmese when required.

The Burman will become as much of a parrot as any other examinee when given the chance, as any officer who has corrected the papers at Tharrawaddy will agree, but this will not do much harm if he has had hammered into him in the forest the principles on which we work in Burma. We do not, I think, at present want to teach our Rangers to make working-plans, but we do want them to know what to do when they are told to start improvement fellings so as to benefit the forest and not harm it, how to lay out and survey a bridle-path, how to control trade fellings and prevent waste, and how to do girdling. It is not long since several divisional officers could show examples of the most disgraceful girdling done by Rangers, and plenty of other cases have occurred showing how little they had attempted to remember what they had been taught. The idea was—get a certificate and there you are! Regarding theory let us have only the simplest elements of sylviculture, botany, etc., taught as much as possible practically whether in the forest or at head-quarters. Surely it is better for a Ranger to know that Pyingado and Padauk are relations, and have similarities and differences, in habit and locality, than to write a yarn about *Xylem* and *Phlœm* which he forgets in a few months? The one is forest learning, the other is book or microscope learning, and from the former he learns to use his eyes. The latter are excellent things in their way, but at present it is more desirable to have a man who can read the four inch map, as so many working-plan coolies can do, than one who talks of *Cephalostachyum pergracile* and *Monochlamydeæ*. If we have plenty of practical work and not too much theory, with proper influence and thorough drilling in essentials, it is probable that Pyinmana will turn out Rangers it will be a joy to work with. That they can be, many officers who know and like the Burmans will agree, and it is with the belief that the majority of officers will concur with the ideas

expressed that the above notes have been made. There is nothing new in them, but there is a great deal that needs to be insisted on.

E. B.

## EXPERIMENTS ON COPPICING SAL IN THE GORAKHPUR FOREST DIVISION, EASTERN CIRCLE, U. P.

BY A. E. OSMASTON, I.F.S.

The December number of the *Indian Forester* for 1909 contained some suggestive remarks on reproduction of coppice shoots, and, acting on these suggestions, experiments were at once started in three working circles in order to obtain some more accurate information.

In one of the working circles the experiments were a failure, but in the other two the results obtained are very satisfactory for a single year's observations, and seem to be sufficiently extensive to enable some fairly definite conclusions to be drawn.

The working circles in which the experiments were made were I and II A., the former comprising an outlying block of forest called Ramgarh, the latter another outlying block called West Lehra. In both working circles, coupe XVII had been marked ready for felling and export during 1909-10, so as to result in the formation of coppice with standards in place of a more or less even-aged high forest of Sal, sixty standards per acre being eventually left.

For the last seventeen years the method of felling has been to cut the trees as low as possible, and latterly to dress the stumps also after felling. The doubtful results frequently obtained by this method of felling, and the often excellent results visible in clear-felled adjoining *zamindari* land led to the belief that possibly the present method of coppicing was harmful rather than beneficial.

Consequently three areas of an acre each in extent were selected in coupe XVII of both working circles, and all the trees on these areas were carefully measured previous to felling.

The areas may be, for the sake of simplicity, termed—

(A) where the trees were felled level with the ground and the stumps dressed in the form of a convex cone;

(B) where the trees were felled 4 to 6 inches high and the stumps dressed as in "*A*";

(C) where the trees were felled 4 to 6 inches high and the stumps left undressed.

From this it will be seen that in "A" the trees were treated as they have been in latter years, and in "C" as they are usually treated in fellings in *zamindari* land, "B" being an intermediate stage.

Owing to the recent drought in these Provinces, which has adversely affected the Gorakhpur forests, there were a good many dead and dying trees in these sample areas, though they were carefully chosen where such trees were least numerous.

For this reason all trees previous to felling were classed as sound or unsound, any trees that showed signs of dying being classed as unsound.

For the purpose of these experiments only sound trees have been taken into account. The trees were felled during January 1910, and had not begun to throw out shoots when inspected on 16th February, but all stumps possessed shoots by the beginning of April. (It is interesting to note that in another portion of the coupe which had been felled at the beginning of October 1909, the stumps had thrown up shoots several inches high by 7th December.)

The usual works of conversion and export were in continued progress in these areas from the time of felling in January to the end of June 1910, by which time the ground had been completely cleared.

The stumps and shoots were measured and enumerated on 14th and 22nd November 1910 in working circles I and II A respectively.

The results obtained for Sal and miscellaneous species will now be considered separately.

SAL.

First, a study of the comparison between the different methods of coppicing may be made by considering—

1. The proportion of successes and failures.
2. The relative height of the coppice shoots, their height being the best criterion of their value.
3. The number of coppice shoots produced on each stool, since it is usually considered an advantage to possess many shoots.

THE PROPORTION OF SUCCESSES AND FAILURES.

The proportion of stumps which produced shoots of one kind or another may be best shown by means of simple curves, one to represent each method of treatment. These curves are given in the accompanying diagram.

The readings from which the curves have been plotted are shown in small capital letters.

From these curves we can deduce the following results, *i.e.*,—

(*a*) That for all classes of trees " A " method is the worst.

(*b*) That for IV and V class trees " C " method is slightly better than " B."

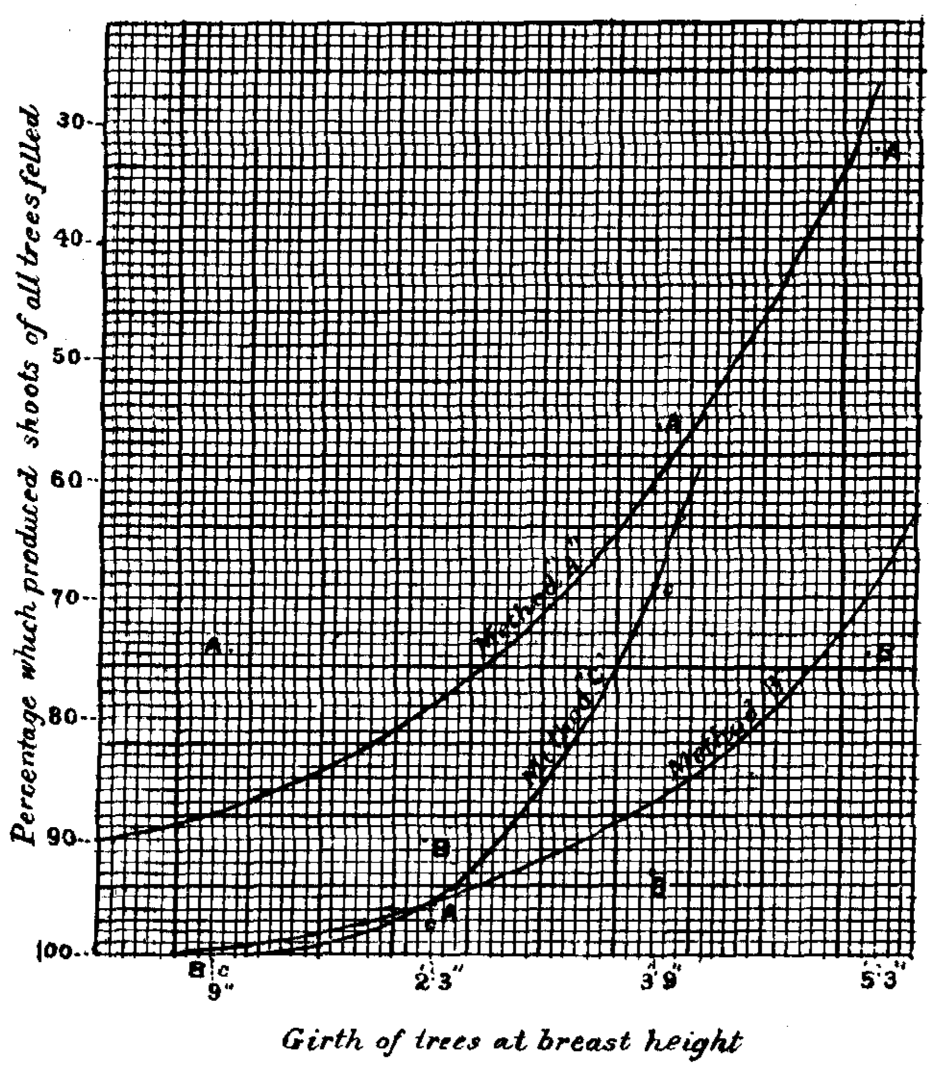
(*c*) That for II and III class trees " B " method is better than " C."

In order to gauge the accuracy of these curves, it is necessary to state that the total number of trees under observation was as follows:—

| | Class I. | II. | III. | IV. | V. |
|---|---|---|---|---|---|
| Plot A ... ... ... | 2 | 3 | 25 | 127 | 78 |
| " B ... ... ... | 1 | 4 | 32 | 113 | 94 |
| " C ... ... ... | ... | 2 | 23 | 177 | 120 |

It may be therefore reasonably concluded that the curve is probably correct for the lowest three girth-classes, but not for the other two.

The theoretical explanation of the first result seems probably that the stumps were subjected to the drying influence of a powerful sun which caused the wood to shrink and the bark to be severed



Percentage which produced shoots of all trees felled
30
40
50
60
70
80
90
100
Method A
Method C
Method B
A
B
9"
2' 3"
3' 9"
5' 3"
Girth of trees at breast height

to an average distance of 2 inches from the top of the stump. This was observed to have been almost universally the case.

The cambium, and such adventitious buds as were present within 2 inches of the top of the stump are in consequence killed. But supposing that the stump has been cut flush with the ground this will kill all the reproductive power of the stump—if, as is believed to be the case with this species, all adventitious buds are situated not lower than 2 inches below the surface of the ground.

The theoretical explanation of the difference between the B and C curves is not so apparent, and it is quite likely that when further observations have been made the curves will be found to take a different form.

THE RELATIVE HEIGHT OF COPPICE SHOOTS.

The average heights of shoots produced by different classes of stumps under the three different methods of treatment is shown below :—

| | | III class. | IV class. | V class. |
|---|---|---|---|---|
| Plot A | ... | 3·25 | 4·55 | 4·05 |
| ,, B | ... | 4·42 | 4·75 | 4·25 |
| ,, C | ... | 4·8 | 4·7 | 4·35 |

Here the figures represent the average height of a stool-shoot in feet. Where there were several shoots from one stump the measurement of the tallest was taken.

These figures seem to show that—

(1) there is a distinct tendency for the larger stumps to produce taller shoots than the smaller ones;

(2) there is a slight but well-marked increase in the height of "B" relative to "A" and of "C" relative to "B."

THE NUMBER OF COPPICE SHOOTS PRODUCED ON EACH STOOL.

The following figures represent the average number of shoots produced on a single stump by different girth-classes under each method of treatment :—

| | | III class. | IV class. | V class. |
|---|---|---|---|---|
| Plot A | ... | 2·35 | 2·45 | 2·2 |
| ,, B | ... | 1·95 | 2·2 | 2·4 |
| ,, C | ... | 2·25 | 1·9 | 2 |

They show that the method of coppicing has little, if any, effect on the number of shoots produced.

Leaving now the question of comparison between the different methods of coppicing and comparing the number of stools which produced coppice shoots with the total number of Sal plants, whether seedlings (the term "seedling" as used here includes all plants and shoots not originating from felled trees over 4 inches in diameter at the base) or coppice shoots, the following interesting results are obtained as tabulated below :—

| Height of shoot in feet. | Total number of seedlings and coppice shoots combined. | | Percentage derived from coppice stumps. | |
|---|---|---|---|---|
| | Working circle I. | Working circle IIA. | Working circle I. | Working circle IIA. |
| 0 to 1 | 40 | 34 | 2·5 | 3 |
| 1 to 2 | 403 | 512 | 4·4 | 6·6 |
| 2 to 3 | 672 | 617 | 3·7 | 13·6 |
| 3 to 4 | 660 | 401 | 5·8 | 30·7 |
| 4 to 5 | 474 | 219 | 9·8 | 52·5 |
| 5 to 6 | 270 | 152 | 9·3 | 73 |
| 6 to 7 | 125 | 84 | 12·8 | 82·1 |
| 7 to 8 | 39 | 31 | 25·7 | 87·1 |
| 8 to 9 | 10 | 25 | 20 | 88 |
| 9 to 10 | 4 | 11 | 50 | 90·9 |
| 10 to 11 | 3 | 4 | ... | 100 |
| 11 to 12 | 1 | 1 | ... | 100 |
| Total ... | 2,701 | 2,091 | 6·8 | 28·7 |

The results are, of course, purely of local value, but to those who are acquainted with these forests they will probably be a surprise.

A casual observation of the coppice coupes would give the impression that by far the majority of plants were coppice shoots ; but this is far from being the case, since there are only 6·8 per

cent. in one working circle and 28·7 per cent. in the other working circle.

This result will be of practical value when in two years' time the present working-plan for these working circles will expire, and it will have to be determined whether the present method of treatment is to be continued or not.

It is far from being a complete success. Every now and then the reproduction fails over large areas, and it is more than probable that this failure is not so much due to the stools not producing shoots as to the chance absence of natural regeneration in the form of seedlings or advance growth.

These particular experimental plots are fair samples of coppice coupes; yet in them only 18 per cent. of the resulting growth was coppice. If, therefore, the whole of this coppice reproduction were to have failed, the area might still have been tolerably re-stocked from seedlings alone; but if, on the other hand, seedlings had been absent, then how different the result would have been!

This consideration will, therefore, be of use in the determination of the future method of treatment of these forests, and if any forests show a decided absence of seedlings and advance growth it would appear an unwise policy to prescribe the method or coppice with standards.

MISCELLANEOUS SPECIES.

No comparison can here be made between different methods of coppicing, as all were coppiced alike a few inches above the ground. But the general results of observations on these species are not without interest as well as practical value.

Firstly, as regards the number of trees which produced coppice shoots:

| | | | | | | |
|---|---|---|---|---|---|---|
| Of 25 | trees | of Asidh (*Lagerstrœmia parviflora*) | | 100% | produced | shoots. |
| Of 22 | ,, | Kajrauta (*Miliusa velutina*) | ... | 100% | ,, | ,, |
| Of 2 | ,, | Jaman (*Eugenia Jambolana*) | ... | 100% | ,, | ,, |
| Of 7 | ,, | Kari (*Saccopetalum tomentosum*) | ... | 86% | ,, | ,, |
| Of 26 | ,, | Pior (*Buchanania latifolia*) | ... | 4% | ,, | ,, |
| Of 12 | ,, | Agai (*Dillenia pentagyna*) | ... | 0% | ,, | ,, |
| Of 18 | ,, | Jigna (*Odina Wodier*) | ... | 0% | ,, | |
| Of 5 | ,, | Kusum (*Schleichera trijuga*) | ... | 0% | ,, | |

This accounts for the scarcity of the last four species in these working circles as compared with others.

Secondly, as regards the height of coppice shoots :

| | | | | |
|---|---|---|---|---|
| The average height of shoots | | of *Lagerstrœmia parviflora* is | ... | 7·8 feet. |
| Do. | do. | of *Saccopetalum tomentosum* is | ... | 3·3 " |
| Do. | do. | of *Miliusa velutina* is | ... | 2·1 " |
| Do. | do. | of *Eugenia Jambolana* is | ... | 4·5 " |

This compares with an average height of Sal coppice shoots of 4·5 feet. The great vitality of *Lagerstrœmia parviflora* in this respect is very clearly demonstrated.

The practical conclusions to be drawn from the above experiments then are :—

1. That the present method of felling trees level with the ground and dressing the stumps, instead of being beneficial, is actually harmful to the production of coppice, and therefore should be abandoned.

2. That the success of the coppice in the present state of these forests depends far more on the presence or absence of seedlings and advance growth than on the development of true coppice shoots.

3. That where Sal for any reason is unsuited to the locality, or coppice reproduction has failed, *Lagerstrœmia parviflora*, *Eugenia Jambolana*, and probably other species not here experimented upon, would be suitable ones to introduce artificially.

These plots will be kept under observation for at least one more year, and new plots in next year's coppice coupes have also been started, and when their results are known and have been compared with those already obtained, it should be possible to solve all doubtful points.

## THE COPPICING POWERS OF BABUL.

BY J. D. MAITLAND-KIRWAN, I.F.S.

Having recently had occasion to read up any information I could find on the subject of Babul (*Acacia arabica*), I have been much struck by the contradictory opinions expressed by various Forest Officers on the subject of the coppicing powers of the tree.

The late Mr. R. S. Fagan distinctly states on page 448 of his article in Volume X of the *Indian Forester* on "The Babul meadows of the Sholapur District" that "Babul does not coppice." Mr. Fagan was an officer who had made a special study of the growth of Babul in the Bombay Presidency, and readers of Mr. Gamble's "Manual of Indian Timbers" are referred by the author to the above-mentioned article for further information about the tree. Mr. Fagan's Working Plan for the Ahmednagar Babul Forests also shows that he had made a close study of the subject; when, therefore, he states that Babul does not coppice we are satisfied that he is not merely giving utterance to what he conceives to be a truism, but that he is telling us the result of his practical experience.

Mr. Srinivasalu Nayadu in his paper dealing with the growth of Babul in Berar read before the Conference of Forest Officers at Nagpur in 1908 gives a modified support to Mr. Fagan's view. He says, "It does not coppice well, though in the early stages of its growth it is able successfully to replace an injured branch or to shoot up anew when the stem gets cut off altogether. In Berar the stems of old trees do not send up shoots at all. Those of trees not exceeding 2 feet in girth send up shoots, but they do not develope into timber."

We may take it, then, that the only use of the very limited coppicing powers attributed to the tree in Berar by Mr. Srinivasalu is that it enables the seedling to repair injuries in early youth, but that the powers are entirely insufficient to enable forests of this species to be treated under any coppice method.

Very different are the views expressed by Mr. Gamble and Mr. A. W. Lushington. In his "Manual of Indian Timbers" Mr. Gamble states with reference to Babul that "It coppices well and may be grown from cuttings." The same officer is quoted in the "Dictionary of Economic Products of India" as suggesting that if grown for its bark *Acacia arabica* "would probably be found most profitable" if treated "in coppice and cut over every 8 to 10 years." From these general statements it is clear that Mr. Gamble's experience was that the coppicing powers of Babul were not merely

limited to the repairing of injuries sustained in early youth, but were so well developed that forests of the species could, in his opinion, be worked as coppice.

Mr. A. W. Lushington's experience appears to have been the same, and in an article in Volume XXI of the *Indian Forester* entitled "Babul in Guntur" written in 1895, he gives an interesting account of the working of the Guntur Babul Reserves. These reserves are, or were at the time the article was written, being treated as coppice with standards with a rotation of twenty years, 5 or 6 standards being reserved per acre. The plan had been in operation two years when the article was written, and Mr. Lushington's observations regarding the coppice shoots are of interest. He writes, "as regards the reproduction from the Babul stumps it was fairly good. About one out of every 3 reproduced by coppice shoots, in places the reproduction was even better—one out of every 2 stools. The height of the coppice shoots after a felling one year back was from 2 to 5 feet, about 2½ feet on the average; after a felling of two years back they were on the average between 5 and 6 feet high." These coppice shoots presumably resulted from fellings made in the coupes of 1893, and, since the rotation is twenty years, the trees in these coupes must now be approaching maturity. It would be interesting to know whether their early promise has been maintained, and whether the areas due to be felled in 1913 have been entirely regenerated by coppice shoots. Perhaps the Officer at present in charge of the Guntur Reserves would give us this information and would state whether the introduction of the method of coppice with standards has been justified in the case of these Babul forests.

It is clear then from the above that the experience of some officers has been that Babul does not coppice, while others have found that it does. Personally I have had some little experience of Babul in the East Khandesh Division of the Bombay Presidency and in the Hyderabad Division of the Sind Circle. Unfortunately I never recorded any notes regarding the coppicing powers of the tree, as I had always been given to understand by Officers who had experience of Babul forests that the tree was for all practical

purposes a non-coppicer, and I never questioned the general application of this statement until I recently read the observations of Messrs. Gamble and Lushington above referred to. My general experience has, however, been very much the same as that of Mr. Srinivasalu. Babul suffers a good deal from frost when young, and in Sind I have seen acres of young seedlings apparently killed by frost which have put out new shoots after a few months, showing that the tree has a good recuperative power when young. I have also observed that moderate-sized stumps sometimes send up a number of weak shoots which never get beyond a small bushy stage, but I cannot recollect ever seeing a properly-developed coppice shoot such, for instance, as those described by Mr. Lushington. Possibly I may have seen such shoots, but if so, they were few and far between, and my small experience of Babul has certainly been that for all practical purposes it is a non-coppicer. I am of course referring only to the power of the tree to send up shoots from the stool. Babul was, I believe, treated in Sind some years ago by the branch coppice method, but this, of course, is a different matter altogether.

It seems, then, to be an established fact that Babul coppices freely in some localities and not at all in others. What can be the reason for this? One would naturally ascribe the phenomenon either to a variety in the species or to a difference of soil or climate, but I am doubtful if either of these alone can be held to account for it. I am aware that there are at least two varieties of *Acacia arabica* recognised, but, although these varieties are well known, I do not remember having read that their powers of coppicing are different, and I imagine that in all the forests referred to the best variety, known as "Godi" in Bombay, would predominate, as it is, I think, the commonest of them and yields the best wood.

As regards the soil one would imagine that the richer the soil, the more likely would the tree be to coppice. I do not know Guntur or what the quality of the soil there may be, but I should very much doubt its being richer than the rich alluvial soil in parts of Hyderabad, Sind, where Babul is seen at its best. I therefore

conclude that it cannot be merely the quality of the soil which causes it to coppice, although I suppose it is possible that this might be due to some local constituent of it; if so, the question could easily be solved by the Forest Chemist.

As regards the climate I cannot speak with any certainty, as I know nothing of the climate of Guntur, but the climates of Sholapur and Sind are quite different, and yet this fact does not seem to have an appreciable influence on the coppicing powers of the tree. In Sind, for example, there are extremes of heat and cold, whereas Sholapur is, I believe, neither so hot nor so cold. In Sind, again, the Babul is under water for two or three months in the year owing to the overflow of the River Indus, and this may be taken as in some ways the equivalent of a heavy rainfall, whereas in Sholapur the rainfall is scanty.

There must, however, be some good reason to account for the fact that Babul coppices well in one place and not in another.

When Mr. Srinivasalu read his paper at the Nagpur Conference, there were present nearly all the Forest Officers of the Central Provinces, as well as representatives from different parts of Bombay, Sind, and the Punjab, and yet I cannot recollect that any one there objected to his statement that Babul did not coppice well. Another Bombay Officer's experience, that of the late Mr. Fagan, I have referred to above, and I do not remember to have come across the record of a case of a Babul Forest being treated as coppice in Western, Central, or Northern India, although of course there may be such cases. The single instance I know of is the one referred to at Guntur in Madras. It is true that Mr. Gamble's suggestion about Babul being treated as coppice when grown for its bark is a general one and that he served in various parts of India, and therefore must have had a wider experience of the tree than the ordinary Divisional Forest Officer, but it is significant that when he made this statement he was, according to the "Dictionary of Economic Products of India," Conservator of Forests, Northern Division, Madras. It is possible, then, that he had in mind the habit of the tree at Guntur, and perhaps elsewhere in the Madras Presidency, when he made this suggestion.

Can it be that the coppicing powers of Babul are merely a question of latitude, and that in Madras and Southern India generally the tree coppices, while in more northerly latitudes it is unable to do so? This is merely a suggestion *faute de mieux*, and if any Forest Officer elsewhere than in Southern India can bring forward facts to show that Babul coppices freely in his Division, it will of course be proved a futile one. Possibly the Imperial Sylviculturist could throw some light on the matter from statistics in his office, and he or some other officer might be able to state if there are other Indian trees which coppice vigorously in some places and not in others and the reasons for this if known. Meanwhile it would be interesting if any Forest Officers in Southern India who have Babul forests in their charge would state what is their experience regarding the coppicing powers of the tree.

The matter is not merely one of academic interest, but has an extremely practical bearing on the working of Babul forests. Babul, it is true, reproduces excellently from seed under certain conditions, but there are times when for some reason or other reproduction entirely fails. I have seen areas in Sind and elsewhere in which the Babul has been clean cut and seed sown artificially as usual, but in which for some reason or other no reproduction has been obtained for several years in succession, with the usual results, namely, the deterioration of the soil and suspension of growth. This failure of regeneration is, of course, one of the dangers of the clear cutting system, and if we could only rely on Babul coppicing, the problem of working forests of this species would be immensely simplified.

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## ENTOMOLOGICAL RESEARCH IN AFRICA.

We doubt whether our readers are aware of the efforts being made to promote entomological research in our African colonies with the object of investigating the spread of disease by the agency of insects.

In order to facilitate entomological study a set of lectures at the Imperial College of Science and Technology is to be given by Mr. Lefroy, F.R.S., F.Z.S., the well-known Indian expert, and, with a view to furthering the work of the African Entomological Research Committee, Mr. Andrew Carnegie has been good enough to place at its disposal a sum of £1,000 a year for three years to defray the cost of sending a few suitably qualified young men to the United States to study the practical applications of entomology which have received so much attention in that country. Three of these Carnegie scholars, as they are to be called, have been selected, and two of them are already at work in the States. The fact that Dr. L. O. Howard, Chief of the Bureau of Entomology at Washington, is personally interesting himself in the matter is a sufficient guarantee that all possible facilities will be given to the scholars, and it may be confidently expected that the scheme will be of great value to British administration in Africa and elsewhere by providing a body of well-trained entomologists available for employment in the services of the different Colonial Governments.

It may be mentioned that the Research Committee was appointed in June 1909, by Lord Crewe, the then Secretary of State for the Colonies, with the object of promoting the study of the insects which play so prominent a part in the spread of disease among men, animals, and plants in Africa; that Lord Cromer is its President; and that it includes some of the most eminent authorities on entomology and tropical medicine in this country.

During the short period of the Committee's existence satisfactory progress has been made. The scheme has been energetically taken up by the African Colonies and Protectorates, and the large quantity of material already received at the Committee's Office in the Natural History Museum at South Kensington has very materially increased our knowledge of the insect pests of Africa. The collections of insects, after being properly identified and recorded, are being distributed to the Schools of Tropical Medicine, Universities, Museums, or other institutions where they are likely to be of value for the purpose of teaching or scientific study. Two skilled entomologists are being employed under the

direction of the Committee in East and West Africa respectively, for the purpose of interesting and instructing the local officials in the work, and also of carrying out special investigations.

The Committee has issued quarterly a scientific journal entitled the "Bulletin of Entomological Research," of which the first volume is just completed. It contains many important articles by well-known authorities, and is obtaining a wide circulation. Further particulars may be obtained from the Secretary of the Committee, Mr. Guy Marshall, British Museum (Natural History), South Kensington, London.

We print below the opening lecture given by Mr. Lefroy, together with a speech delivered by the Earl of Cromer at the Imperial College of Science and Technology on the 2nd March. The fact that the College has been able to avail itself of the services of Mr. Lefroy, alone furnishes sufficient evidence that the lectures will not only be full of instruction but be of exceptional interest as coming from an expert who, after gaining a large experience in the West Indies, was admittedly the highest authority on Entomological subjects in the East. Mr. Lefroy is now on furlough from India, there being, we imagine, small chance of his returning, as once scientists at home get hold of an expert of his calibre, they do their best to keep him and we are not surprised.

THE EARL OF CROMER INTRODUCED THE LECTURER IN THE FOLLOWING SPEECH:—

The sole justification for my presence here this afternoon is that, knowing nothing of entomology, I was somewhat on the *lucus a non lucendo* principle, invited by Lord Crewe, when he was Secretary of State for the Colonies, to preside over the Committee of Entomological Research. It was, I think, a happy inspiration of Lord Crewe to appoint this Committee. I hope and believe that it will be able to render some valuable public services.

I think it may possibly be of some general interest if I state briefly what the Committee has done since its creation.

The objects of the Committee are to stimulate an interest in the study and observation of insects in general, and of noxious

insects in particular, throughout our tropical Colonies, and thus gradually to organise a regular army of collectors and observers who will accumulate the information needed to enable us to cope with the numerous insect pests which cause disease and death amongst human beings and animals, and which also devastate the crops. Our two travelling entomologists have received instructions to traverse the whole of our Colonies and Protectorates in tropical Africa, and wherever they can find any official or other resident who desires to interest himself in these matters, they supply him with the necessary apparatus for the work, and give such practical instructions as may be required. A preliminary survey of this kind has already been made throughout Northern and Southern Nigeria, Nyasaland, and a part of British East Africa. Our entomologists report that they are more than satisfied with the results so far achieved. Considering the paucity of the white population, the number of men who have volunteered to assist in our work is highly creditable to the Colonies concerned.

Considerable collections of insects likely to prove of great importance are now being regularly received at the office in the Natural History Museum which has kindly been placed at our disposal. Arrangements have been made with various specialists to identify all this material. Named specimens are then returned to the collectors for their future guidance, the remainder being distributed among the Tropical Schools of Medicine, Universities, Museums, etc.; in fact, wherever they are likely to be of value for purposes of instruction. The full development of an organisation of this kind must, of necessity, be slow; all the more so because the men who are doing the field work have, for the most part, had no previous training in entomology. Until recently this subject has not been taught seriously in any of our principal educational institutions. In view of the great importance of the subject, it is satisfactory to know that this defect is now being rapidly remedied. But even so, there is a tendency to treat the subject merely as a side issue in a general course of agriculture or medicine. There do not appear even yet to be any adequate facilities of study for the men who would desire to obtain a sound general training in

entomology as a whole. The Imperial College of Science and Technology have therefore inaugurated courses of lectures for the express purpose of meeting requirements of this kind. There can be no question that the innovation is sound and valuable. It is to be hoped that the enterprise of those responsible for introducing it will receive the encouragement and support which it certainly deserves. The fact that the work has been placed in the very capable hands of Mr. Maxwell Lefroy, Imperial Entomologist to the Government of India, who is about to address you, should ensure its success, for he has had great experience in the practical study of insect-life, not only in India but also in the West Indies.

There is another aspect of entomological instruction which is sadly in need of more attention in this country, though it is one which would perhaps hardly come within the scope of the College of Science. I allude to practical field training in the methods of combating insect pests of all kinds. Our deficiency in this kind of teaching is continually being brought home to the members of the Research Committee when applications are received from Colonial Governments and other Institutions, asking us to recommend the names of experienced economic entomologists. It is perhaps not generally realised how extremely few in number are the young men trained in this country to whom that description could be properly applied. In these circumstances we have gladly accepted a very generous offer from Mr. Andrew Carnegie, who has kindly agreed for three years to defray the expenses incident on sending three or four young men, selected by the Committee, to the United States, in order that they may receive a thorough training in those practical methods of dealing with noxious insects which have been so successfully applied in that country.

It is to be hoped that the experiment may eventually lead to a more business like appreciation of the value of economic entomology in this country. The first step would be the establishment of experimental stations, where the value of such work could be practically demonstrated, and where men could get the requisite field training. Nor should there be any insuperable difficulty in

gradually building up a system under which it would be possible for an agriculturist whose crops were suffering from some unknown or imperfectly known pest to send to the experimental station for the assistance of an expert. This expert might then undertake the work of exterminating or mitigating the pest, thus giving the farmer a practical training in the methods of coping with it. A reasonable fee would have to be charged for the service rendered. I fear, however, that such an institution could scarcely be expected, in the first instance at all events, to be entirely self-supporting.

With these preliminary observations, which I trust you will not consider out of place on the present occasion, I will now ask you to listen to Mr. Lefroy, with the confident assurance that what he has to say cannot fail to be of great interest.

THEN FOLLOWED THE INAUGURAL LECTURE ON APPLIED ENTOMOLOGY.

By H. MAXWELL-LEFROY, M.A., F.R.S., F.Z.S., Special Lecturer on Entomology, Imperial College of Science and Technology, South Kensington, Imperial Entomologist for India, which we reproduce *in extenso.*

This lecture is the first of a series dealing with general entomology, with special reference to the application of the science to agriculture, commerce, medicine, and sanitation. There is at present no one general course of lectures or training in entomology as a special subject given in England, and it is fitting that such a course should be initiated at the Imperial College of Science and Technology, whose function is to provide the highest instruction in branches of science which have practical application.

Entomology used to be concerned with the study of insects solely from the biological and systematic sides; that is, entomologists were more concerned with studying the habits of insects and with classifying them than they were with checking and controlling them or with exploiting them as part of the world's commerce. Even now the value of the economic entomologist and the part he plays in daily life is very little appreciated in this country; there is in England no Government Entomologist, no

entomological experiment station, and no organisation which does for the country as a whole what economic entomologists do in India, in our Colonies, and in the United States. In order to make clear to you what function an entomologist serves, I must refer mainly to the work they do in our Colonies and in India, and as I have for eleven years worked in the West Indies and India as Government Entomologist, I can more easily select my illustrations from the work which I have seen myself in those countries.

Applied entomology, which is a development of pure entomology, deals with insects which affect man; the greater number of insects affect man directly in no way at all; they have an indirect bearing on man, as they have their part to play in the economy of the earth; they scavenge and cleanse the earth; they pollinate flowers and make possible the fruiting of many plants; they populate all parts of the earth's surface, except the sea, and in numbers of kinds, as in actual abundance, they exceed all other forms of animal life visible to the naked eye. In these respects they are of interest but not of direct importance, and while the study of insects is a fascinating branch of natural history, there would not be any necessity to have economic entomologists if they did no more.

The study of the larger animals, of birds, of fishes, and of snakes, is intrinsically more interesting to the average zoologist and nature-student; their importance and influence on man are more obvious; and it is perhaps due largely to this that entomology has come to be a specialised branch of science, till now confined more to the differentiation and classification of the immense number of forms than to other branches of study; it is thus less developed from the economic and technical aspect than are other branches of zoology or the sister sciences of botany, chemistry, and electricity. It is only lately that the significance of the insect world has become apparent; and it is mainly owing to the immense importance of tropical entomology that the study of insects from the economic aspect has received its greatest impetus. The opening up to agriculture of new tropical countries, the increasing competition in the cultivation of tropical products, the discovery of the part played by insects in disseminating human

disease, have brought entomology to the front, and have shown that, far from being a science concerned solely with the minute classification of interminable varieties and species, it is a science which has a great significance for man, and one which requires to be developed in serious earnest if we are to be in a position to harvest our crops, to cope with disease, and to populate tropical areas successfully. In closely cultivated countries with temperate climates, insects have not the significance that they have in tropical countries and in newly-planted areas, and it is perhaps due to this that in the study of economic entomology England is somewhat behind America and some other nations.

Out of all the hundreds of thousands of kinds of insects which now live on the earth, a small proportion are of very vital importance to man, affecting his agriculture, his cattle, his merchandise, and causing or transmitting disease to man on a very large scale. It is these with which we are now concerned, and it is on their account that the economic entomologist comes to play so important a part at the present day.

All plants, whether crop plants or wild plants, are affected by insects, which live on them, destroy them, lessen the value of their produce, and increase at their expense. In nature, this is limited and checked; but in cultivated crops, grown in blocks, under artificial conditions, these insects become abundant, increase beyond proportion, and take a very perceptible part of the crop.

It is not only as agents of destruction that insects have a great economic significance; large industries depend directly upon insect activities, and the useful insects are no small item in man's economy. Bees offer the most familiar example; the production of bees'-wax and honey is dependent upon a very few species of domesticated bee, which man has exploited and whose products have been obtainable in no other way. This is now a profitable industry to many thousands of bee-keepers in practically every country, and the production of honey and wax is now carried on on a very large scale.

Silk is another very large insect industry, which has existed for centuries, but which has, in the last century, benefited

enormously from the application of scientific study. Silk is produced mainly by one species, formerly wild, now domesticated, and also by a few wild species and some minor domesticated ones; the study of these insects by entomologists has had, and is having, remarkable results in the industry, and the production of silk is one of the big industries of the world which might be very much extended in the British Empire; the total production of the chief grade of silk, raw silk, is about forty million pounds annually, worth about twenty million pounds sterling, and there is also the waste silk, tussore, shantung, eri, and other kinds, totalling probably as much again.

Another industry which is less familiar is the shellac industry; lac is the resinous covering produced by a few species of scale insects living on trees in India and Burma, and Malayia; the value of the production in India and Burma exceeds three million pounds sterling annually, and no substitute for this insect product is as yet known. Scientific entomology is only now beginning to be applied to this insect, but there is a large field for research and improvement, and some progress has been made. Other minor insect industries there are also; the cochineal insect in dyeing, the blister beetles in medicine, the various insects used as food are examples, and there is a considerable trade in insects used as food for birds.

Nor is it certain that there are not great possibilities in the future; while science has to a large extent exploited the plant world for commercial products, little has been done systematically with insects, and while there are important insect industries in India, other tropical areas may have unexploited possibilities which the future will bring forward. The subject is so new, so little investigated, that it is impossible to say what products the systematic investigation of tropical fauna may bring out. There is here a large field for research and inquiry, and one in which England, with the vast tropical areas she is colonising and opening up, is particularly interested.

It is, however, from the destructive side that insects are of the greatest significance to man, and though the results of practical

entomology are in a sense indirect, they are of very great commercial importance. Cotton is a crop in which commerce is at present very deeply concerned and whose production in the Empire is being extended; in this crop destructive insects play a very great part; it is probable that were there no boll worms, no cotton stainers, no cotton caterpillars, the gross yield of cotton from the area now existing would, without further effort on man's part, be increased ten to twenty per cent.; in Sind and the Punjab in one year the cotton crop failed wholly from the attack of the boll worm; the loss in cotton not produced was in excess of £2,000,000 sterling, and this was due solely to the work of one cotton pest. The same applies very markedly to cotton which is introduced into new localities or to new varieties introduced in new areas; the first trials of Egyptian cotton in many parts of India failed wholly from the unforeseen attacks of the pink boll worm; in the trials made of tree cottons in many countries it has been found that the pests are the factor determining success or failure. If the pests are neglected, it is commercially impossible to grow tree cottons in India at the present time, and for want of realising this much money has been wasted; in every cotton-growing country insect pests are of the first importance, and no one growing cotton in any part of the world can afford to neglect them.

The same may be said of very many crops; every crop has its pests, and we have to deal with them efficiently if we are to cultivate crops as commercially successful undertakings. The pests may be virulent special ones, such as the woolly aphis of the apple, the phylloxera of the vine, the destructive moth of the potato; these limit themselves to special crops and, if not treated, the *industries concerned are ruined. Or the pests may be general* ones, such as locusts and swarming caterpillars, which attack almost all crops and which devastate large areas, appearing every few years in great abundance and doing great damage. In all countries crop pests are known, more so in the tropics and in countries where very large areas are given up to growing a few crops, as in the wheat areas of Canada, the cotton areas of the United States, Egypt, and India. In England the conditions of agriculture and

climate, the dense cultivation, the high standard of cultivation, and the availability of scientific resources make such large attacks impossible, and we cannot quote striking cases, *though the aggregate damage done to crops is still large;* but in other countries, notably in the tropics, these attacks reduce the crops over very large areas, making systematic campaigns, carried on with all the available resources of Government, a necessity. In the Bombay locust outbreak of 1903-4 we spent £14,000 in fighting the pest; in Massachusetts on the gipsy moth campaigns as much as £20,000 to £40,000 were spent annually in checking the pest; and similar sums are spent—and are well spent—in similar campaigns in other countries. These sums are only a proportion of the loss these countries would otherwise sustain were these pests not checked, and we are not able to estimate the gross losses sustained by agriculturists throughout the world. A recent report puts the loss sustained in the United States from the pear thrips, a minor pest, at one million dollars annually, and in the United States, where the organisation of entomology renders figures available, the total loss from destructive insects is put at three hundred million dollars annually. In British India, the losses to the eight principal crops at a conservative figure amount to fifteen million pounds per annum, and to the country as a whole, in all crops, amount to well over double that amount.

Were these losses unpreventable, these figures would be of no value, but very largely the losses are preventable, either by the individual action of farmers themselves or by collective action on the part of the people, aided by Government. Whatever this action is, it must be founded on and guided by scientific entomology, *i.e.*, on an accurate knowledge of the lives and ways of the insects causing the losses. Year by year the successes of entomology grow greater; a notable case is the success of the collective action of the South African Colonies against their locusts; the migratory locusts of North India and the Bombay locust are now fought successfully; the potato moth, which in India and Australia did so much damage, has been checked by simple means within the reach of the cultivator; the phylloxera of the vine and

the woolly aphis of the apple have been met by the introduction of resistant stocks on which the pests will not live; and if there are many cases where remedies or preventives are as yet beyond the reach of the farmer or where no profitable remedy has been discovered, there are far more cases where remedies or preventives are applied with profit and success.

I will quote a case where we have definite figures: In 1905 the cotton crop failed over 700,000 acres in the Punjab; eight districts reported no yield at all, four reported a quarter crop, and one a crop a trifle over a half; in 1906 we adopted three remedies, impressing them on the cultivators with all the resources of Government, but not actually spending any large sums of money; one remedy was a failure, two were successful. In 1906 the districts that had no yield in 1905 reported an average of 53 per cent., those with a quarter yield reported 62 per cent., and a loss of two and a half million pounds sterling was reduced to one of only seven hundred thousand pounds sterling in the next year, and the crop has since been normal. These remedies were not introduced into Sind, and in 1906 the cotton crop there was again a failure till, in 1907, we applied remedies and produced a normal state of things. We have campaigns of this sort going on year by year in India and in our Colonies, and it is this class of work that our entomologists are constantly engaged in. There are many problems to be solved, but the experience of the past has shown that the application of entomological science to similar problems has been very largely successful.

Nor is this sort of large combined campaign the only method that has proved successful; probably greater aggregate good is done by teaching farmers about their pests and by means of lectures, leaflets, and coloured illustrations, giving them reliable information, teaching them how their pests live, and giving them the best technical information about remedies and insecticides.

This is the main work of the economic entomologist, and the success of it depends upon its accuracy, its practical utility, and its being available to every farmer or planter who requires it. To do this work requires a thorough knowledge first of pure entomology:

it is based upon a groundwork of thorough knowlege as a whole, and before any beginning can be made, very thorough training is required. It is this training which we hope to give, rendering available for England and the Empire men thoroughly skilled in entomology, able to apply themselves to practical problems without having to acquire a knowledge of entomology to begin with.

In other ways also, the influence of destructive insects is fully shown ; our cattle and domestic animals suffer from insects in a very marked way ; the warble in cattle is stated to effect over 48 per cent. of the hides exported from India, and the loss in the value of American cattle passing through Chicago in six months was put at over three million dollars ; sheep suffer from maggots in the brain, horses from bots in the stomach, and most of our valuable domestic animals have parasites of one kind or another.

In forestry the influence of destructive insects is very marked ; in nature, where the forest is undisturbed, matters adjust themselves to a large extent, but the earth is being cleared of natural forest and man is making forestry a business in which artificial conditions are established, the natural law is upset, the balance of life is altered, and outbreaks of insect pests become a very serious matter. The loss annually in American forests is put at twenty million pounds, and the losses in tropical forests are probably much higher. In planting and working large areas, in the preparation of working plans for felling and re-planting successive areas, the influence of insects and the methods of meeting them cannot be neglected, or the losses from this cause become enormous.

Nor is this loss confined to the growing plant or animal ; from the time it is harvested to the time it is consumed, grain, timber, and food-stuffs must be guarded and protected ; the ravages of weevil in wheat and rice amount to a very serious total, especially in hot countries. In India, the loss in wheat amounts to over a million pounds sterling annually and the loss in rice to probably three times that on the average. Flour, meat, dried fish, dried fruits, almost every form of food must be preserved very carefully if insects are not to infest it. We have had to deal with flour moth in flour mills, with beetles in brush factories, woollen clothing

stores, and leather factories, with beetles in tobacco factories, and with boring beetles attacking bamboos, wood, and the like. In the tropics, the white-ant is a very destructive agent; a commission is working now on the railway sleeper problem in India, the white-ants finding railway sleepers excellent food in some parts of the country, and this problem involves a very large amount of money. Every working entomologist has abundant experience of these and similar problems, and it is an important part of his work to cope with these pests.

Here in London, in a temperate climate, you will think I am drawing an exaggerated picture, but I am not doing so, and if I take my illustrations from the tropics very largely, it is because it is there the cases are the more striking and numerous, and because I have worked there so long. *The problem is the same here*, and the pioneer work in England of Curtis and Miss Ormerod in the last century showed what losses there were and started the development of the subject.

In all these cases, whether on crops, domestic animals, or stored products, there is but one way of meeting the problem, and that is, first study and then the application of common-sense remedies based upon that study. We can do nothing until we know our insects, know how they live, where they lay their eggs, how long the eggs take to hatch, where the grub lives, how it feeds, how long it lives, and every detail of its life from start to finish. That is a matter of scientific enquiry, and it is only on this knowledge that we can base our remedies or preventive measures and hope to either fight the pest or show farmers how to do it for themselves. We have to study the insect as a living being, to keep it in captivity and breed it, to watch it in the field, to find out its enemies, its peculiarities, and really know its life and habits at all seasons of the year before any progress is possible. There is no magic that we can use, no one perfect simple remedy that fits all cases, no universal insecticide; for each case careful study, then experiment in the field, and then, with the co-operation of the farmer, the testing and application of remedies on a large scale. It is with this that scientific entomology is concerned, and it is

only in this way that progress is possible. In India the cultivator will tell you that the caterpillar that bores in his canes comes from the well water he irrigates with; a little investigation shows that the caterpillar comes from eggs laid in clusters on the leaves of the cane, and that, with some borers at least, these eggs can be cheaply and simply removed. This is a very simple instance of what I mean by the study of the pests' habits, and every successful remedy or preventive is a similar instance. The economic entomologist does this only, and his object is to find a weak spot in the life-history of the insect, where, by some simple measure or by some modification of the local agricultural practices, he can destroy the insect or make its occurrence impossible.

In all the cases I have mentioned up to now, insects affect man indirectly, but the last twenty years have shown that insects have a great significance also as carriers of disease to man and to domestic animals, and we are here confronted with a very large and difficult problem. It is common knowledge now that malaria is communicated to man by the bite of one of several kinds of mosquitoes; to those who have lived in the tropics the significance of this will be obvious. Few Europeans in the tropics escape malaria; many die from it, and the mortality from malaria among Europeans and natives in a bad season may be awful. Since this discovery was made, it has been found that other diseases are carried by mosquitoes and other biting insects; yellow fever is carried by a mosquito common in the tropics, so is filariasis by other common mosquitoes; the rat flea is the agent which spreads plague; the tiny midge of the genus *Phlebotomus* carries Pappataci and similar fevers; the large flies of the genus *Glossina* carry sleeping sickness to man and similar trypanosome diseases to cattle, horses, and dogs. The common bed-bug is suspected, but not definitely convicted, of carrying kala azar and similar diseases. It is no exaggeration to say that these discoveries opened a new field, and, when one considers the dreadful mortality these diseases cause, a very wide one. The significant point in attacking these diseases was thought to be the germ or organism carrying them; but the insect is now shown to be at least as important and, in many cases,

a far more attackable point. Plague in India has been a terrible scourge and might be so in Europe; but the plague flea and the plague rat are far more easily controlled than is the plague germ, and it is on them that the spread of the infection depends.

Let us see what occurs in plague. A plague rat, that is a rat infected with the plague germ, is, we will say, let loose in London or anywhere you please; its fleas suck its blood and draw in the plague germ; the rat gets worse and dies. As its body gets cold, the fleas leave it to seek another rat or some other warm animal on which they can live; they bite that animal and give it plague also, thereby infecting other fleas, which leave that rat when it dies. Now, were these fleas only to bite rats, the disease would stop there, but they do not. They bite man also, incidentally, and he gets plague, and probably dies of it. That is why, in India, when rats begin to die, the people at once have to avoid being bitten by a flea from a dead plague rat, and if they are wise they leave their houses. Now, clearly, here one link is the flea, and we want to know all about it; where does the flea come from, where does it lay its eggs, how does the grub live, and so on. Instead of using disinfectants to kill the germ, which was supposed to live in the dirt of the house, we now use insecticides to kill the fleas and to prevent them breeding. One reason why Europeans in India seldom get plague is because they live in clean houses, where fleas cannot breed or live. If there is going to be an epidemic of plague in England, it is to the plague rat and the plague flea we must turn our attention.

The problem is, then, to a large extent an entomological one, and so in all insect-borne diseases, it is the insect we have to study and to fight. Here again it is in the tropics more than in England that the work lies, and it is perhaps difficult for anyone who has not lived and suffered in the tropics to realise the immense importance of entomology in this respect. However one lives, mosquitoes and sandflies bite one, the flea comes off the dead rat and jumps on to one, the bed-bug lurks in railway carriages and public places, and there is no escaping the ubiquitous disease-carrying insect; if it is bad for Europeans, it is worse for natives; since

plague re-commenced in India, in 1896, seven millions of people have died, people living in small houses, with little idea of sanitation, with small means, and no power of understanding what plague was or how it came. What precautions can they take against fleas, or how can they leave their homes and their work if rats begin to die round them? It is the same with malaria; in a bad season, as in the Punjab in 1908, and Behar in 1909, the mortality in the villages from malaria was truly awful. The mosquitoes can get to them and bite them; the one man who starts the infection may be the means of infecting scores of others and so long as the mosquitoes last the epidemic continues unchecked. I wish I could paint a real picture of what these insect-borne diseases mean in the tropics and of the wastage of life they entail; when it is realised, one realises also the part the entomologist must come to play in the future, and the absolute necessity, if the tropics are to be opened up and cultivated, of this special kind of preventive entomology being adequately developed. If we are ever to colonise the tropics, if we are to people them with healthy races, to develope them agriculturally, and to render available the immense amount of raw material they are capable of producing for England's manufactures and trade, it will be only when we have organised the entomology and successfully tackled the insect transmitters of disease. A great deal has been done, especially on the medical side; the advances in tropical medicine of the last twenty years mark an epoch, but we are behind in our entomological organisation, and we want to take the matter more in earnest.

In England, if mosquitoes and sandflies do not bite, there are dangers of an equally serious nature from the house flies and flesh flies, which carry the typhoid germ. Flies which settle on food may carry and do carry germs on their feet and on their proboscis; the common fly should be vigorously exterminated and kept down, and in this respect there is very much to be done in this country.

Nor is it only the very vital demands of the present we have to look to. What does the future hold for us in this respect? Sleeping sickness has come into great prominence in the last few years, mainly because the areas in which the *Glossina* flies occur

have been opened up and the disease has now affected persons not immune to it who were formerly not in reach of the infection ; the opening up has increased the range of the disease. What is going to happen in the future as the tropics are opened up and rapid communication established to fresh tropical areas ? Are we going to get more and more diseases communicated by insects, now confined to tropical jungles, but brought within our range by increasing means of communication ? Is the yellow fever going to reach Indo-China and India, for instance, by means of infected mosquitoes carried by ships from the Panama Canal when that is opened ? The yellow fever mosquito is already in India, but not the germ, and while a yellow fever patient cannot carry it a mosquito might. Is the sleeping sickness transmitter going to spread ? Is plague going to establish itself in Europe and carry off thousands and millions in England ? These speculations are quite justified on the analogy of sleeping sickness alone, and it is essential to make sure that our entomology is up to the standard of our medicine, and when the time comes that we shall be ready to tackle the insect that transmits the disease.

I may seem to have overdrawn the picture of the importance of the insect world, but, truly, anyone who has lived in the tropics will know that I have not exaggerated. From the medical and sanitary point of view the entomologist is going to be very important, and in the last few decades the agricultural entomologist has already found his place. In the old days, the profits on tropical agriculture were very large, and the losses were inappreciable ; but that is so no longer. Larger areas are under sugar, tea, coffee, *cocoa, and other products ; the yields of wheat* on virgin *soils* are no longer obtained, and the farmer all the world over has found he must look to the small percentage he loses by insect pests as representing a great part of his profits. He can neglect it no longer and when he wants help it is to the official entomologist he must turn.

If we are to be ready it will be only if entomology in the British Empire is organised and developed in a better way than it is at present. In all branches of applied entomology, our chief

need is trained workers, and it is a curious fact that though there are in the Empire more than thirty working economic entomologists, there is not in England any institution which trains economic entomologists or which gives a complete course of instruction in entomology. Our Colonies recruit their entomologists from America or take untrained men who get their training from experience, which is an expensive way. We should be able to recruit our men from England, as we do with all other branches of science, and it should be here in England that the training in entomology, which must be acquired before any practical work is possible, should be available. It is the object of the course which this lecture inaugurates to make a beginning with this training, and to try to do for England and the Empire what similar institutions have already been doing for years in America and other countries. It is the function of the Imperial College of Science and Technology to supply the highest technical instruction in science, and it is fitting that such an institution should provide training in a subject of such importance.

England has recently sent three students to America to be trained in economic entomology, through the generosity of Mr. Andrew Carnegie; but surely, seeing that our Empire has economic entomologists, and that our entomologists cope with as large problems as do the American Department, we should be able to provide the scientific training here in England and give our workers the special instruction required for coping with these problems in the tropical areas of the Empire. Work as good as any in America is being done in our Colonies and tropical possessions; we want a great deal before this work will be properly organised and carried on; we want larger means, more men, less overworking; we want to differentiate research from executive work, and not expect the same man to do research, teaching, executive work, and the administration of pest Acts; we want to develop a class of what we may call executive entomologists for organising and carrying on campaigns; we want co-operation between different parts of the Empire, between England and the Colonies; but our greatest need at present is a training institution, a source of supply of young

men properly trained in entomology and specially selected for the peculiar qualifications required in the economic entomologist. We must continue to depend upon America or to trust to luck unless we have this, and it is our hope that we can provide such a course and that the scientific training can be given here. England is not behind in other branches of entomology, and in the Colonies the work of practical applied entomology is as highly developed, considering the available resources, as it is in America; but we want to develope it in England, to organise the work, to provide a thorough course of training, and so be able to provide for England and the Colonies the trained men that are wanted now and that will still more be wanted in the near future.

## A METHOD OF MEASURING THE HEIGHT OF STANDING TREES.

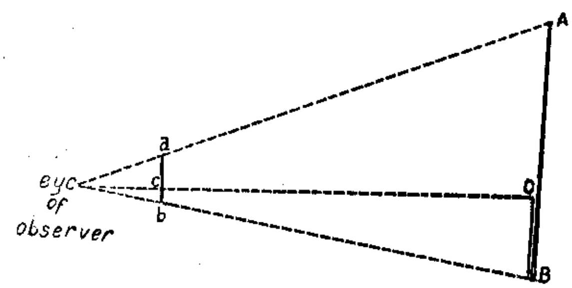
The want of some simple and practical method by which the heights of trees may be measured at any time has long been felt by Forest Officers. Nearly all accepted methods entail the use of some special instrument, which is usually not at hand just when required. It is true that a measuring tape is all that is required in order that the height of a tree may be gauged from the length of its shadow, but it is often impossible to apply this method on hill-sides, unless complicated calculations are made to allow for the slope of the ground.

The method about to be described is a modification of "Christen's Method," which is familiar to all students of Vol. III of "Schlich's Manual of Forestry." The main difference is this, that an ordinary 2 feet rule is used instead of the specially graduated metal bar known as "Christen's Hypsometer."

A staff of known length is taken and placed against the tree whose height is to be determined. The observer then takes his stand at a convenient place, holding the 2 feet rule near the upper end between the forefinger and thumb, so that it hangs vertically. The rule is then moved backwards or forwards away from or towards the eye, until the upper and lower ends coincide with the

top and foot of the tree. The point on the rule which coincides with the top of the staff is then read off. The distance from this point to the bottom of the rule is the "apparent length of the staff." If the total length of the rule is divided by the apparent length of the staff, then, by the principle of similar triangles, the ratio borne by the height of the tree to the actual length of the staff is obtained. This ratio multiplied by the actual length of the staff gives the height of the tree.

The following diagram illustrates the principle of the method :—




AB = the tree to be measured.

CB = a staff of known length.

ab = the rule, and

cb = the apparent length of the staff on the rule.

Then AB : CB = ab : cb

and $AB = \frac{ab}{cb} CB$.

The advantages of the above method are as follows :—

(1) No special instrument is required. A 2 feet rule is easily carried about and is possessed by nearly every Forest Officer. Any branch or bamboo which is handy can be cut to a convenient length to form a staff.

(2) The length of the rule can be varied from 24 in. to 18 in. or 12 in. to suit the requirements of the case. Christen's hypsometer is invariable in length. If a short bar is used the readings obtained for tall trees are very unreliable, as a difference of say 10 feet in the

height of the tree is represented by a very small difference on the instrument. If, however, the bar of the instrument is long and the tree to be measured is short, it is not possible to hold the instrument sufficiently far from the eye to get the top and foot of the tree to coincide with the upper and lower ends of the bar.

(3) A staff of any length may be used. A convenient length is 10 feet, as the calculations are simplified. Christen's hypsometer is graduated for use with a staff of one particular length, and if any other length is used, more or less complicated calculations have to be introduced.

In one respect, however, Christen's hypsometer is superior in *that the height of the tree is read off directly* on the instrument, provided of course that a staff of the proper length is used. With a 2 feet rule the height has to be calculated. The calculations are however very simple, and may be made once for all and incorporated in a table showing for any apparent length of staff the figure obtained by dividing the total length of the rule by the apparent length of the staff, or—referring to the diagram—the value of $\frac{ab}{cb}$ for various values of cb. This figure has only to be multiplied by the length of the staff (CB) to obtain the height of the tree.

It is not claimed for this method that it is one of any great accuracy. It retains some of the inherent defects of Christen's method, such as the difficulty of getting the upper and lower ends of the instrument to correspond accurately with the top and foot of the tree. The degree of accuracy also decreases with the *height of tree, though this can be counteracted to* a certain extent by using the rule at its full length for tall trees. The method owes its origin to the necessity for measuring a standing tree when no instrument was handy, and this description of it is written with the hope that it may prove useful to other Forest Officers under similar circumstances.

The following table gives values for the ratio between the length of the rule and the apparent length of the staff $\left(\frac{ab}{cb}\right)$ corresponding to various values of the apparent length of the staff which

may be read off on the rule. These figures have only to be multiplied by the actual length of the staff to give the height of the tree.

| Apparent length of staff on the rule. | Values of $\frac{ab}{cb}$ | | |
|---|---|---|---|
| | When length of rule = 24″. | When length of rule = 18″. | When length of rule = 12″. |
| 1″ | 24 | 18 | 12 |
| 1⅛″ | 21·3 | 16 | 10·7 |
| 1¼″ | 19·2 | 14·4 | 9·6 |
| 1⅜″ | 17·5 | 13·1 | 8·7 |
| 1½″ | **16** | **12** | **8** |
| 1⅝″ | **14·8** (15) | **11·1** (11) | 7·4 |
| 1¾″ | **13·7** (14) | **10·3** (10) | **6·9** (7) |
| 1⅞″ | **12·8** (13) | 9·4 | 6·4 |
| 2″ | **12** | **9** | **6** |
| 2⅛″ | 11·3 } (11) | { 8·5 | 5·6 |
| 2¼″ | 10·7 } | { **8** | 5·3 |
| 2⅜″ | **10·1** (10) | 7·6 | **5·1** (5) |
| 2½″ | 9·6 | 7·2 | 4·8 |
| 2⅝″ | **9·1** (9) | **6·9** (7) | 4·6 |
| 2¾″ | 8·7 | 6·5 | 4·4 |
| 2⅞″ | 8·3 | 6·3 | 4·2 |
| 3″ | **8** | **6** | **4** |
| 3⅛″ | 7·7 | 5·8 | 3·8 |
| 3¼″ | 7·4 | 5·5 | 3·7 |
| 3⅜″ | **7·1** (7) | 5·3 | 3·6 |
| 3½″ | 6·9 | **5·1** (5) | 3·4 |
| 4″ | **6** | 4·5 | **3** |

The more important figures are in bold type.

The figures in brackets are whole numbers corresponding to the decimal numbers after which they are placed. In practice these whole numbers will always be used instead of the others.

MAIBATTA:
*29th March* 1911.

H. S. GIBSON,
*Assistant Conservator of Forests.*

## THE PRINCIPLES OF HANDLING WOODLANDS.*

(BY HENRY SOLON GRAVES, CHIEF FORESTER, FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE.)

This volume, as the author explains in his preface, has been written to supply the need felt in America of a work dealing with the sylvicultural treatment of woodlands. It is by no means a complete treatise on sylviculture, nor is it intended to be such, but it deals with conditions existing in American forests to-day and endeavours to show what is the best sylvicultural treatment which

* John Wiley and Sons, New York, $1·50 net. Chapman and Hall, Ltd., London.

may be applied to them while those conditions exist. As many of these conditions are identical with those met with in India at the present time, such, for instance, as widespread damage from reckless cutting in the past, prevalence of forest fires, poor markets and lack of data, it will readily be understood that the methods of treatment recommended by the author are extremely simple, practical rather than ideal, and he wisely resists the temptation to describe in detail the more intricate European methods which he appears to have studied.

The book falls naturally into three parts. The first chapter contains the Introduction, the next five deal with the Sylvicultural Methods of Treatment and the Improvement of the Forest, while the last two chapters are devoted to Forest Protection.

In his introduction the author states that at the first settlement of America there were about 850 million acres of forest, and he estimates that since 1870 an average area of 50 million acres has been burnt annually. So great indeed has been the damage to the forests from fire and other causes that at the present day "the actual growth upon them is less than one-third of what is actually used in the country." A number of forests are in the hands of private owners who have not the means to protect or treat them systematically, and to these people the author holds out the hope of State aid in various ways at no distant date.

After explaining the objects of sylviculture, the financial aspect of forestry and other introductory matters, the author proceeds to discuss the chief sylvicultural systems as applicable to American forests, giving one chapter each to the selection, clear cutting, shelterwood and coppice systems.

The systems are on the whole well described, but here and there occur statements which invite criticism. For instance when describing the selection system the author lays down on page 50 that "unless all age classes are normally represented the cutting must be at irregular intervals." Practically however this is not so; the representation of age classes in selection forests is frequently abnormal, but it is quite possible (and usual) to arrange for annual fellings of an approximately equal amount of material without at

all interfering with the proper sylvicultural treatment of the forest. We think, too, that a little more might have been said about the cutting cycle in selection forests. It is an important matter to fix the length of this correctly, and although the reader is told on page 47 that it may vary from 10 to 50 years he is rather left in the dark as to why the variation should be so great. The conditions which should guide the Forester in fixing the length of the cutting cycle might, we think, have been clearly enumerated.

The clear cutting system is discussed in considerable detail, and a number of modifications of the system are described. The shelterwood system appears, with some exceptions, to be applied in a very primitive way in America. Regeneration is secured and the crop removed by means of two cuttings only, one of which is called the " first or seed cutting," the object of which is to encourage reproduction, and the other the " second cutting," in which the remainder of the old crop is removed. It is stated on page 145 that " usually the second cutting will not be made until the first cuttings have been completed through the whole forest." Presumably, however, the whole forest would not be regenerated at once, but would be divided into periodic blocks, each of which would be taken in hand separately. We quote this instance to show that the author has not thought it necessary to say much about the manner in which forests are divided into working circles, blocks, compartments, etc., and, although it is true that a detailed description of the various divisions and subdivisions belongs rather to a work dealing with Working-plans, yet the sylvicultural systems are dealt with at such length in the book under review that we think an elementary description of the manner in which the forest is subdivided is necessary in order to enable the reader thoroughly to understand them.

The coppice system is treated under four heads—Simple Coppice, Holding over Reserves, Polewood Coppice and Coppice with Standards. Under the system of holding over reserves the standards are to be left for two rotations only, but under coppice with standards for several rotations. There seems to be no advantage in treating these as two separate systems, and in our opinion

they should both be classed as coppice with standards. The polewood coppice system is recommended for forests in which a short rotation is impracticable on account of the lack of demand for small material. The trees are therefore allowed to grow to such a size that when they are cut reproduction from the stool cannot be relied on and regeneration must be supplemented by establishing many seedlings. A method of this nature should not, in our opinion, be included among the coppice systems at all, for in coppice forests it is a *sine qua non* that the rotation should be short enough to ensure reproduction from the stool. A forest cannot be called a coppice simply because, by design or otherwise, there is a proportion of stool shoots in the crop, and the type of forest classed by the author as polewood coppice should, we think, be treated under the clear cutting or one of the shelterwood systems; in fact he states on page 181 that "this system is in reality, therefore, the shelterwood system with a short rotation."

In the chapter on "Improvement of the Forest" the author deals with various kinds of improvement cuttings, thinnings, pruning, etc. He does not distinguish clearly between cutting for the improvement of crops to which, on account of immaturity or some other reason, no sylvicultural method has been applied and cuttings carried out for the improvement of young crops which are being worked under a definite system. No doubt both ideas are present in the chapter, but no distinction is drawn between them, and all the cuttings are classed as "improvement cuttings" (page 90). The two kinds of cuttings are however quite distinct, and in India the first class are known as "improvement fellings" and the second as "tending of the crop."

The author then passes to the consideration of forest protection, and it is significant that out of 96 pages allotted to this subject 84 are devoted to fire protection. He first describes the nature of fires, their causes, and the damage done by them, and then discusses the steps which may be taken to prevent them and to extinguish them when kindled. The subject is fully dealt with, but calls for no particular comment, as fire protection must of necessity follow very much the same lines in all countries. The

author notes that in fully 75 per cent. of the private forests there is no attempt whatever at systematic protection.

We would suggest that in the next edition a glossary of technical terms should be inserted, as some of the words and phrases used are very puzzling to the uninitiated. Some terms, it is true, are explained in the text and others by footnotes, but of many no explanation is given.

The author has always endeavoured where possible to give an idea of the average cost of various operations, and this is a very useful feature of the book.

The book itself is well got up, and printed on paper of good quality. It contains a large number of very excellent photographs explanatory of the subjects dealt with, and these will certainly be of the greatest help to the student.

We think that the volume on the whole is well adapted to the purpose for which it has been written.

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## A FLY'S EYES.

Anyone who has tried with outstretched hand to catch a fly cannot fail to have noticed its wonderful alertness in escaping. One reason for this is the fact that the fly was watching the movements of its would-be captor out of all or most of its eight thousand and three eyes. Another reason for its rapid retreat is that instead of seeing one hand coming towards it the fly would have seen at least 7,500 hands all looking alike, and all moving down upon it in the same direction. A third reason of the fly's nimbleness is its ability to vibrate its wing nearly 700 times a second, and to travel through the air at the rate of a mile in two minutes and a half or twenty-four miles an hour.—[*Agric. Gazette.*]

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## TALLEST OF TREES.

In New South Wales, Victoria and Tasmania grows a species of gum tree, *Eucalyptus amygdalina*, which probably represents the tallest of all trees of the globe.

The loftiest specimen of this tree yet measured towers to the height of four hundred and seventy-one feet. A prostrate tree, measured in Victoria, was four hundred and twenty feet long, and the distance from the roots to the lowest branch was two hundred and ninety-five feet. At that point the trunk was four feet in diameter, and three hundred and sixty feet from the butt the diameter was still three feet. The wood of this tree is hard and of good quality, it grows quickly, and yields a great quantity of volatile oil from its leaves, which are very abundant.—[*Scientific American.*]

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# INDIAN FORESTER

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## THE INFLUENCE OF FORESTS ON DROUGHT.

[*Contributed.*]

The Forest Officer educated in the schools of thought that have prevailed on the Continent of Europe for the last century or more, holds as one of his most fixed principles that forests, particularly in mountainous regions, act as Nature's storing house for the waters that fall from heaven, preventing their too rapid surface flow and consequent running to waste, minimising their evaporation and giving them off gently in the shape of perennial springs and rivers with an equable flow. He will tell you that forests effect this in several ways all tending to the same result; he will assert that the area covered with forests will receive more rain than will an adjoining one from which the forests have disappeared, and will show that against 6 per cent of the total rainfall which percolates more than 2 feet into ground uncovered with forest, 60 per cent does so in the case of forest lands covered with vegetable mould. This absorption is facilitated by the roots of the trees which break up the soil in a forest country, allowing the free percolation of moisture. The

Experiment made by Ebermayer prove that this is the case.

Forest Officer can also prove that evaporation is less than half inside a forest what it is outside it, that the snow in the forests melts more slowly than it does in open country at the same elevation, and that the amount of moisture thus saved is stored up in the forests for future gradual use—and he will hold that the greater portion of this moisture stored up in the forest humus and soil goes to feed the underground water-tables and is the important factor in maintaining perennial springs and an equable flow of water in rivers throughout the year. More particularly forests in mountainous regions have been regarded from time immemorial as the preservers of moisture and their protection in the interests of the water-supply, if for no other reason, has been generally held to be justified. This was early recognised on the Continent where several special French laws have been enacted from time to time, by which Government could apply special protective measures to forests which were held to influence the water-supply. In Prussia a law was passed in 1875, under which the destruction of forests which have a protective character, whether as regards the soil and its protection from erosion and landslips or as regards the water-supply in rivers and streams, could be prevented. The same principle has been recognised in India where the provisions of Chapter VI of the Forest Act can be applied to any forest or waste land in the interests of the water-supply. Indeed, whether on the Continent of Europe or elsewhere, many forests may correctly be classed as "protective," the rôle of which in nature is the protection of the soil from erosion and landslips, and the chief yield of which is *water*.

Schlich's Manual of Forestry, Vol. I, page 40.

Law of 28th July 1860 and subsequent laws of 1864 and 14th April 1882.

In a recent memorandum published by the Weather Bureau of the United States, the statement was made that forests have no effect either upon the amount of rainfall or upon the severity of floods; that ploughed fields will hold water quite as well as the ordinary humus of the forest, and that it is believed that no case can be shown where deforestation has augmented droughts and floods. In a former article we discussed the influence of forests

on rainfall and floods, and we will now endeavour to examine briefly some of the facts that are at our disposal regarding the influence of forests on drought, explaining that by drought we do not mean failure of the rainfall but rather the failure of the water-supply, whether of wells, springs or rivers. If it can be shown that in areas well covered with forest the springs are perennial and the rivers do not run dry, and if in adjoining areas receiving the same rainfall but denuded of their forest growth a contrary state of affairs, leading often to great extremes of flood and drought with consequent distress and trouble exists, the Forest Officer's principles as set forth above will be justified.

Schlich, Vol. I, page 41.

First regarding the statement that ploughed fields hold water as well as the ordinary humus of the forest, the writer forgets two points: first that field crops use up in their growth far more of the moisture held in the soil than does a forest crop, thus leaving less to be stored up for the water-supply, and secondly, that in the winter the surface of ploughed fields often becomes frozen as hard as iron, in which condition practically no moisture can percolate into the soil. Under the forest, however, the soil will be found soft and capable of absorbing moisture, whether from snow or rain, long after ploughed fields are frozen hard and have ceased to be able to do so.

See "American Forestry," February and April 1910.

Before attempting to examine available facts bearing on the influence of forests on the water-supply, we may notice that Professor Moore's statement that no case can be shown where deforestation has augmented droughts and floods has attracted much adverse criticism in America, and has been refuted by many eminent authorities there, *e.g.*, the Hon. Curtis Guild, Mr. John H. Finney, Professor Swain, Filchert Roth, and many others. Numerous examples are given in the pages of that interesting Magazine "American Forestry" showing that great extremes of floods and drought follow disforestation. A notable example of the contrast between the superfluity of water at one time and its paucity at another was given by Doctor Rothrock in the case of Johnstown, Pennsylvania.

Page 155, "American Forestry," March 1909.

Referring, first, to the flood of some twenty years ago, which practically swept the town out of existence, he said :—

"Last spring I passed by Johnstown. It is a great mining region. The hills around there are denuded of timber * * * There is nothing to hold rain and every hillside was weeping water. The whole surface was saturated with it, and the Conemaugh was a raging flood. Six weeks ago Johnstown, cursed by a previous flood and blessed last spring by a copious supply from the clouds, was in a vastly different condition. The people were glad to get their drinking water from the puddles around the town."

Commenting on the statement made that Forest Reserves do not promote regular stream flow, Mr. Guild remarks: "It is in direct opposition to the experience of China, of France, and of Spain, where the denudation of forest-clad hills has led to a succession of freshets and droughts on what were once fertile slopes and, except where reforestation has taken place, has reduced the agricultural population that once tilled those soils by sweeping away the very soil itself."

Page 69, "American Forestry," February 1910.

The main arguments of the American writers are naturally based on the opinions held and facts ascertained on the Continent of Europe, for observations in America have not been carried out over a sufficiently long period to provide many reliable local data. In the French Forest Magazine "Revue des Eaux et Forêts" for January 1st and 15th, 1909, an article appears entitled "La Capacité retentionelle de la forêt," and of this article a translation is given in "American Forestry" for March 1910.* The article gives a temperate summing up of European researches upon the effect of the forest upon the water-supply, and its perusal is recommended to all interested in this question. We cannot attempt to follow all the arguments, some of them anti-forest, advanced, but will content ourselves by quoting some of the examples given of the effect of deforestation on the water-supply.

At the congress on navigation held at Milan in 1905, Mr. Ponti gave in his paper a striking picture of the condition to

* Page 158, "American Forestry," March 1910.

which Sardinia was reduced after the clearings made on the island in 1870, which lowered the percentage of forested area from 43 per cent to 26 per cent; floods in the rivers became more rapid, channels were filled with débris, and bridges were carried away. In Sicily, deforestation has likewise had the effect of raising the level of the river-beds, in the Province of Campobasso (Molise) cuttings made over one-third of the land surface deepened the beds of the streams greatly, and caused the breaking down of the river banks to such an extent that one-tenth of the ground was carried away. Reforestation has produced opposite effects in the Province of Grosseto (Tuscany), Avellino (Campania) and Sondrio (Lombardy). In Sondrio reforestation diminished the floods. Mr. Ponti also cites the floods of the Adda in 1806 and 1817, and of the Malero, 1834, which followed very closely upon deforestation.

Mr. Lokhtine's paper, read at the same conference, treats principally of the action of forest vegetation on the flow of springs and streams. The savant cites numerous examples of streams that have dried up and disappeared following deforestation. It is in this way, he says, that the springs around Rome, Vienna, and Constantinople disappeared after cuttings had been made on the hills that surround these cities.

A Roman aqueduct brought to Orleans water from hot springs: there is not a trace left of these springs to-day. Becquerel reported the case of a stream at Caunau, in the commune of Labruguiére (Tarn), which in former times furnished power for several mills. After the deforestation of the slopes of the Black Mountain this stream was subject to sudden floods, and its flow diminished to such a degree that work could no longer be carried on. After the denuded areas had been reforested, the flow increased and became more regular; the mills were re-opened and could be operated uninterruptedly.

The hills that surround Heilbronn (Wurtemberg) are covered with a forest growth, which is subject to regular cuttings made every 20 years. It has been noticed that the flow from the springs diminished when the soil was denuded following a cutting, and

that it increased when the forest growth had gained possession of the ground again.

Marchal cites similar cases in Switzerland. The Swiss engineer, R. Lauterburg, states that, for an equal area, springs issuing from forested watersheds have a flow five to ten times greater than those from denuded watersheds. According to the same author, the destruction of the forests that took place in the canton of Tessin during the first half of the nineteenth century reduced by more than one-quarter the flow of the Adige during low water periods.

Messrs. Shriner and Copeland, who mapped four townships around Monroe (State of Viscensin, United States) in 1904, observed that the percentage of forested area in this region had been reduced in a period of 70 years from 83 to 6 per cent. The water level of the rivers had lowered steadily ; the consequences of deforestation had become more apparent than ever since 1887. More than 40 kilometres of streams are dry during the entire year ; numerous mills have ceased to operate.

In Kazan, on the tributaries of the Sviyaga River, there were formerly 70 mills which operated steadily. Scarcely 30 are left, which are idle during summer for lack of water, and are operated with one-third as many millstones as formerly.

The influence of forest vegetation on the flow of springs and uniformity of stream-flow is manifested very clearly, says Mr. Toursky, in the upper basin of the Dnieper, where all the streams and small rivers issue from forested territory and have a regular and constant flow. In Central Russia, on the contrary, deforestation has dried up the streams ; in the grounds surrounding ancient manorial houses fish-ponds have dried up and there is no water in the parks, where streams formerly flowed under ornamental bridges of bizarre forms.

The lowering of the average stream level of the Scura at Pranzine from 1888 to 1900 followed upon extensive clearings on its watershed. A lowering has likewise been observed in the average stream level of the Bielaja at Oufa from 1887 to 1900, following upon clearings made on its upper watershed ; on the

contrary, the level remained the same at Grouzdevka on the lower watershed of the Bielaja, where the forests were preserved. The average stream level in summer of the Volga was lowered at Rybinsk, at Kostroma, and at Nijni-Novgorod, following the deforestation of that part of the watershed. The diagrams that accompany Mr. Lokhtine's report show these variations in a striking way.

The springs of Bresle dried up about 1840, after the clearing of a forest of some importance, situated in the parish of Formerie (Oise). The source of the Arrivaux River descended toward Breuil (Somme) one kilometre soon after the forest of Cressy was cut in 1837. The clearings made in the forest of Arronaise were injurious to all the streams that flowed from it to Escaut and Somme.

Mr. E. Charlemagne has given an instance to the point in the "Revue des Eaux et Forêts" of the disastrous effects that the needless cutting of forests may have upon stream-flow. After the death of Don Bouthillier de Rancé, the abbé of la Trappe leased the ironworks connected with the monastery to private parties for 12 years. It was necessary, according to the biography of Don Pierre the Dwarf, sub-prior of the monastery, "to destroy the forests of la Trappe in order to maintain the furnace fires, and it is impossible to tell how far-reaching the effects were. The springs soon dried up and the ponds yielded water only six weeks in the whole year." This was written in 1715.

Near the little village of Orgelet (Jura) at the foot of the east slope of the Orgier Mountain, in the parish of Plaisia, there is a spring called the fountain of Plaisia which disappeared during the entire time that the mountain remained cleared of its forests (from the end of the eighteenth to the middle of the nineteenth century) and reappeared 30 years ago when the work of reforesting the slope had been finished. Numerous inhabitants of the country testify to this fact.

Mr. Alphonse Mathey has noted an interesting fact in an article entitled "The influence of the forest on the flow and the regularity of springs." According to the testimony of the Mayor

of Flacey (Cote d'ôr), the spring supplying his village had always had a constant and regular flow as long as the limestone uplands, from the foot of which it issued, remained covered with a coppice of vigorous oak over an area of 100 hectares. At the beginning of the nineteenth century, this area having been deforested, the spring no longer had a regular flow and entirely ceased to flow the greater part of the time.

The same author recounts observations made by Mr. de Rothenbach, director of the water service of the city of Berne, on the flow of the springs of that city. The flow per minute of two of them, the Schliern and the Gasel, varied from one to two and seven-tenths and from one to four and one-tenth, while the variation of a third spring, that of Scherli, is represented by the numbers one and six and seven-tenths. Now the basin of the springs of Gasel and Schliern is sheltered by a considerable mass of forests, while the source of Scherli flow from a mountain partly deforested. These investigations clearly prove that the presence of the forest tends to give the springs a regular and constant flow. Other observations also prove that the forest, during dry times, gives out slowly the water that it has stored up during a rainy period. Thus, during the summer of 1893 which was marked by a long and destructive dry period, the spring of Scherli reached its smallest flow on September 3rd, 1893; that of Gasel did not reach its low water mark until three months and a half later; that of Schliern six months and a half later.

Mr. Hüffel has, moreover, described in his "Économie Forestier" the experiments carried on since 1900 in the valley of the Emmenthal, by the Swiss Central station of forestry research, in order to compare the flow of two water-courses, one issuing from a basin containing only eighteen per cent of forest area, the other from a basin covered with forest over ninety-one per cent of its area. The learned professor has just announced that the verifications made up to the present have established :—

First, that at the time of the maximum of high water the channel of the deforested region carries thirty to fifty per cent more water per unit of surface than the wooded region.

Second, that after prolonged dry periods, the springs of the deforested region dry up completely and the bed of the stream is dry, while the stream from the wooded valley is still yielding at least five litres of water per second.

In France we have numerous proofs of a notable diminution in stream flow. The Durance, which rises in a partially deforested drainage basin, has become absolutely unfit for navigation or for floating timber. Yet, at the time of the Roman occupation, there was an important organisation of boatmen on that river.

The Loire was formerly a navigable channel of the highest order, which afforded sure communication between Nantes and the central provinces. In 1551 the Marquis of Northampton, ambassador from England, went from Orleans to Nantes, with his suite, in "five large, many cabined boats." Numerous pictures dating from the eighteenth century represent Orleans and Blois animated with veritable flotillas of boats of every kind.

At the present time navigation, almost nil on the Allier, is impossible on the Loire above Saumur. The bed of the river has risen with frightful rapidity because of the enormous volume of matter torn from the soil of the mountains of the central plateau that it carries with every flood. It has been shown in fact that the remains of Roman villas recently discovered on its shores are several metres lower than the present level of the river-bed. It is the same with the old Roman churches, into which it is necessary to descend as into caves, and yet it is impossible to suppose that their architects built them below the level of the river. The building of dikes, instituted in the seventeenth century along the Loire to protect the cultivated fields of the valley against the overflowing of the river, coincides exactly with the time of the clearings made on the mountains of the central plateau, that Colbert tried in vain to check.

On account of deforestation, the Loire, like the Allier, is no longer in summer anything but a great stretch of sand. Let a storm come, a sudden thaw in spring, or prolonged rains in the autumn and "every depression of the ground gathers a torrent, every ravine confines a river, and all these waters, accumulated

in the valley of Loire, form a roaring sea, which reminds one of the great rivers of America." At Roanne, the flow at low water and the flow at times of flood is in the ratio of 1 to 1,458. The flow at Orleans oscillates between 24 cubic metres per second and 7,500, which is more than 300 times the flow at low water. Five days are sufficient to restore the almost dried up river and to raise the water level 6 or 7 metres.

The Pyrenees offer numerous examples of the sad effects of deforestation upon stream-flow. Dralet, in his "Description of the Pyrenees," published in 1813, tells us that the Tet, a small stream of the eastern Pyrenees, could not be used to float rafts and timber after the removal of the forests that covered a part of its upper drainage basin. The Salat and its tributaries, likewise but lately floatable, are only torrents now that the mountains that overlook their valleys have been cleared of forests. In the parish of Saint-Girons one can see yet, in a wall built in 1130, chains which were used to hold rafts; in 1813 they were found to be at an elevation of one metre and had become useless, the navy no longer finding wood to cut in the territory around *Seix and Castillon.* The Salat was formerly navigable from the port of Saint-Girons to its confluence, and the village of Lacave, 16 kilometres below Saint-Girons, was at that time the centre for the building of boats for river navigation.

Many other similar instances of the deterioration of streams and drought following disforestation in Europe are given in the "Revue des Eaux et Forêts," but let us now pass to India where an enquiry into the influence of forests on water-supply has lately been held at the instigation of the Government of India. Here, as in America, observations have not been carried out for a sufficient length of time. Nevertheless many interesting and notable facts have come to light bearing on this question, a few of which nay be quoted.

In Berar, there has been destruction of forest in the northern portion of the Melghat, and the stills used for the extraction of Rusa oil have now to be located lower down the stream owing to lack of water at their former sites above.

From Burma, Mr. Watson, Deputy Conservator of Forests in charge of the Southern Shan States, writes: "I have no doubt whatever that disforestation is responsible for the scarcity of water in many places, notably in the Myelat plateau, and this fact is so patent that the natives in many localities admit it." He shows that this plateau covering some 200 square miles was originally covered with fine forest which has gradually been exterminated by shifting cultivation so effectually that to-day over perhaps half the area scarce a tree is to be seen, and that as a consequence the water-supply has become scarce. During the rains the streams are subject to very sudden and violent floods which subside as quickly as they rise, leaving the beds of the streams almost dry. Mr. Watson further shows that some Palaungs, a Shan tribe, who live principally by shifting cultivation, were located in the catchment area of the Paung stream, a large feeder of the Zawgyi river. As a result of the clearings made by them in five years, the water in the stream dried up and they were obliged to migrate elsewhere.

The Kywedat village, situated on a feeder of the Zawgyi river in the Lawksawk State, was formerly surrounded by extensive rice fields—these have now been unworked for years owing to the failure of the water-supply following the deforestation of the surrounding hills.

There is evidence showing that 20 years ago, a perennial stream flowed past the village of Thebya in the Lawksawk State. The catchment area of this stream has been denuded of its forest growth and the stream now runs dry every hot weather.

The Deputy Commissioner of Magwe, after fully reviewing the situation, and giving numerous instances of failing water-supply due to disforestation, sums up as follows.—

"I consider the evidence recorded in Magwe to point conclusively to decrease of rainfall, deterioration of streams and alteration in the character of crops synchronising with great destruction of forests. The example of this district is important because this deplorable change is so recent as yet to be within the memory of living men, whereas the period when the same process occurred

in Pakokku and the bulk of the dry zone is too remote to be more than a faint tradition. On the other side it is said since the reservation of large blocks of jungle along the Yoma, east of Taungdwingyi, the Sedaung stream is gradually improving again. The Magwe district offers altogether an admirable object-lesson."

Striking instance of the preservation of the forest growth regulating the flow of a stream is furnished by Popa Hill in the Myingyan district, Burma. Before the present Popa Reserve was formed and the clearing of the hillsides prohibited, the stream which runs by Popa village used to give a very precarious supply of water in the dry season, and one year completely dried up, with the result that the village and the Military Police Post which was there at the time had to be temporarily abandoned. Since the reservation and fire-protection of the forests on Popa Hill, there has always been a copious supply in the streams in the driest season of the year.

Mr. F. H. Todd, Deputy Conservator of Forests, Mandalay, states :—

"About 50 years ago the villages at the sources of the Samon, Thinbon, Mendaing, Shawgan and Myin-Uhle streams in the Meiktila district and those near the sources of the Sindewa and Tin or Taungzine streams in the Myingyan district used to be very unhealthy owing to the density of jungle, but now that most of the jungle has been cut by toddy-climbers and ya cultivators these villages suffer every year from drought. Even 30 years ago they had a plentiful supply of water, both from springs and from the above-mentioned streams, but now these have almost completely dried up.

In Bengal, it has been possible to compare two rivers, the one flowing through reserved forests, the other with its catchment area stripped of its protective verdure. These are the Koina and Rora rivers in Singhbhum, both 30 to 45 miles in length. The former drains a tract of country of which 80 per cent is reserved forest, and holds a plentiful supply of water throughout the year. The latter flows through country almost entirely denuded of

forest. Its water runs very low even in the cold weather, while in the hot weather it dwindles away to nothing.

An influential Committee was appointed in 1908 to examine the question of denudation of forests in Chota Nagpur and Orissa. The Committee established that there had been very great destruction of forests in Manbhum, Ranchi, Singhbhum, Sambalpur and Orissa, due to over-exploitation by contractors, extension of cultivation, wasteful and reckless cutting by villagers, fires and overgrazing. They found that the subsoil water level is very low in most places in Chota Nagpur. Wells are 40 to 50 feet deep, and in most parts of Ranchi even these dry up at the beginning of the hot weather. The Committee considered it proved that streams in Government reserves last longer through the hot weather than streams of the same size in a denuded area, and were so convinced of the importance of preserving the forests that they drafted a Bill, which is now under consideration, in order to give Government power to insist on the protection of forest growth or reafforestation on waste lands not the property of Government.

With instances like these, which might be multiplied almost indefinitely, before us, it does not seem open to doubt that forests do play an all important part in preserving moisture and in ensuring an equable flow in springs and rivers, and that their destruction will be followed by devastating torrents alternating with severe droughts whether in America, Europe, India, or elsewhere.

## SYLVICULTURE IN BURMA.

[*Contributed.*]

In any undertaking it is desirable to keep clearly in mind the objects to be aimed at, and carefully to consider the means to be employed to attain those objects, but in none is foresight so essential as in forestry, where the length of one's service is so small in comparison with a life of a tree that one cannot hope to see the fruition of the work attempted. Owing to the multitude of petty details to which we have to attend, there is, I think, a danger that we may lose sight of broad general principles, and it may be worth

while, therefore, to spare a few minutes to take stock of what we actually are doing, and to consider the probable results of our work as a whole. Seeing that the Annual Forest Administration Report is carefully prepared every year for this very purpose, this may seem somewhat superfluous, but this report only gives details of the extent and cost of each work, and gives no information showing the comparative value of the different works. It does not enable us to form any idea whether the works are good, bad, or indifferent, and therefore it is impossible to judge whether any progress is being made or not. Even in working-plans little attempt is made to calculate the value and effect of the sylvicultural operations proposed, and in fact I have not been able to find in any official document any estimate of the progress being made, or any forecast of the effect on the outturn of our sylvicultural operations.

There can, I think, be little difference of opinion as to the object we have to aim at. It is, I think, to improve the value of the forests so as to ensure an increased outturn, and as regards the means, I think it is evident that we should endeavour to utilise a small staff and limited funds to the best advantage. As there is a possibility that our views may have been biassed by the theory and practice of Europe where we get our training, I would suggest that the essential difference is that, in Europe, where forestry is more advanced, land of greater value, etc., the object aimed at is to utilise every acre to the best advantage, whereas in Burma, where the bulk of the growing stock is unmarketable, the most that can be attempted is to ensure a better yield per acre. Similarly as regards the means to be employed, in Europe where the staff is large and the divisions small, the only precaution necessary is that *good* value should be obtained for the expenditure, whereas in Burma we have to consider not only whether a work is profitable, but whether it is the *most* profitable and effective means for our purpose. It may be interesting to note to what extent our different works fulfil these conditions.

The following is a list of all the works which may be classed as sylvicultural operations :—Fire-protection, Works in connection

with plantations, Creeper cutting, Improvement fellings, and "Other cultural operations."

Fire-protection was in 1909-1910 attempted over an area of 7,727 square miles, or roughly a third of the reserved forests, an area greater than that brought under working-plans. The cost amounted to Rs. 2,92,130 which is roughly one lakh more than was spent on all other sylvicultural works combined. It would appear therefore that in Burma we consider fire-protection the most profitable work on which to concentrate our energies and available funds. It is however generally admitted that, although annual fires cause some damage, the value of the damage done is only equal to a fraction of the money spent on protective works, or in other words that fire-protection entails a waste of money. A further disadvantage is that continued fire-protection prevents natural reproduction of teak, destroys seedings, saplings, and young growth which sprang up before the introduction of fire-protection, and that if continued indefinitely it will result in the extermination of teak, the main source of our revenue. This may seem exaggerated, but so far as I am aware hardly a Forest Officer in Burma disputes these facts.

As regards the work in connection with plantations, the area of taungya and regular plantations, exclusive of rubber plantations, amounts to 79,088 acres, or roughly 123 square miles. The cost of creation and upkeep up to date is given as Rs. 10,19,659 and Rs. 8,01,459 respectively. It is probable that the area given is too great as in some cases the original area has been reduced by the encroachment of the neighbouring forest and by the unsuitability of the locality. The figures of the cost are also misleading because no account has been taken of what is the principal item, namely, the cost of the permanent establishment employed in attending to them. The work requires skill and cannot be left to subordinates, and wherever plantations have been made their maintenance has proved a great tax on gazetted officers. The particular point of view, however, from which I wish to regard this question, is whether or not these plantations improve these forests. Instead of being made in a compact block they have been purposely

scattered throughout the natural teak forest which has increased the cost and labour of maintenance, but they have not, I believe, greatly benefited the forests in their neighbourhood. On the contrary they have proved breeding grounds and centres of infection for pests such as *Hyblæa puera* and bee-hole borers. They have, on the other hand, increased the stock of teak and other marketable species, but the final yield, even of pure forest, when spread over some 30 or 40 years, will be no great matter. It seems to me that this work is more suitable for a treeless country, where it is necessary to produce timber in the shortest possible time, than for a country like Burma which contains great natural forest wealth. Personally I am of the opinion that plantations will eventually yield a fair profit, but consider that this work should be considered as an outside investment which has the drawbacks that it absorbs much of the time of the available staff and that no appreciable return will be obtained for 100 years or so.

The amount spent on other works is comparatively small. Creeper cutting is, I think, generally recognised to be useful work, but it is not even dealt with separately in the Administration Report. In most areas brought under working-plans however creeper cutting is carried out over one-thirtieth of the area each year, and the cost seldom exceeds Rs. 160 a square mile. The work requires no skill and is usually entrusted to forest guards, who, for the convenience of inspection, complete it before the area is girdled over. Many creepers however, when cut back, throw up strong shoots, and as the operation is only repeated at long intervals, it is doubtful whether the relief is permanent. Creepers sometimes smother the crown of a valuable tree, or so restrict the growth where it winds round the stem, that when removed a big groove is left. Still the percentage of trees injured is not very great, and as few are actually killed, and as the cost is small, the work may, I think, be fairly described as a minor operation.

Most Forest Officers agree that improvement fellings are also a useful work. The work consists of freeing teak from suppression by less valuable species, and as the growing stock is uneven aged

it can be readily understood that the smaller trees and saplings have difficulty in obtaining sufficient light, and that teak, being a light demander, suffers heavily on this account. Although the work is not considered of sufficient importance to require a special form, yet owing to the increasing attention paid to it, a statement is generally given in the body of the report, showing the extent of work done during the year. From this it appears that the area gone over last year was 85,990 acres or roughly 134⅓ square miles and that the cost amounted to Rs. 46,535 or Re. 0-8-8 per acre. Seeing that the area of reserved forests is 25,691 square miles and that of reserves brought under working-plans 7,279 square miles it is evident that at present little progress is being made.

Other cultural operations may be briefly mentioned. A certain amount of work is carried out in felling trees attacked by epiphytic *ficus*, the cost of which is frequently included in that of improvement fellings. The idea is, I believe, to exterminate the species, but as the seed is carried long distances by birds I do not think this work is likely to have any appreciable effect, and as the felling of trees attacked by *ficus* is laborious and expensive work, I do not believe that any profit can be expected from it. Sowings are also made in bamboo flowered areas, but so far as I can ascertain usually without result.

Teak seed is also sometimes dibbled in, in gaps and open places, but I believe without much success.

Nurseries for fruit trees, exotics and roadside trees may perhaps be mentioned as they are included in form 61, but there are not, I think, any other works of sufficient importance to be specially mentioned.

In order, however, to ascertain whether we are increasing the outturn or even maintaining it, it is necessary to give some account of the exploitation. It is a matter of common knowledge that the search for teak has been carried on into the uttermost parts of Burma, and I think it would now be impossible to find an area, rich in teak which has not been already exploited, or where arrangements have not been made to go over it in the near future. There are many forests, remote from villages, which from fear of

wild animals or fever even jungle Burmans are afraid to penetrate, but attracted by high rates of pay, and feeling security in numbers, a girdling gang is got together who scour the forest in all directions, and with anxious yells call the girdling officer to his work of destruction; as it is written "where the carcase is there will vultures be gathered together."

Much can be done to maintain the yield by regulating the outturn, as is done when a working-plan is prepared. The general principle adopted is to go over a forest in 30 years and to take out all trees which during that period have attained a girth of seven feet. At first however there is a considerable surplus of overmature trees which, had the forest been systematically exploited previously, would have disappeared many periods ago. The number of trees to be girdled during the first period is therefore very much greater than can be expected in subsequent periods, and in addition the volume is very much greater owing to the higher average girth. It is inevitable therefore that there must be a considerable fall in the outturn so soon as this surplus is removed, and however skilfully it is done, this cannot be avoided merely by regulating the yield.

The removal of a large proportion of the seed-bearers must also react unfavourably on the reproduction and therefore ultimately on the outturn.

Moreover for economic considerations it is of great importance that we should keep pace within the demand. With the opening out of the province, increasing wealth and higher standards of luxury, the demand for teak is steadily increasing. Knowing that *the outturn must decrease so soon as the surplus is removed, it is* our obvious duty to insist on the necessity of carrying out adequate sylvicultural operations, not only for the purpose of counteracting the effects of exploitation, but in order to meet the demand for a greater outturn. The short description I have given of the present sylvicultural works may enable us to estimate what measure of success is being achieved by our arduous efforts.

To sum up, in many forests nothing is being done. In all the more valuable teak-bearing tracts however, over an area of about a

third of the total area of reserves, we are making most energetic attempts to keep out annual fires. As this work has the same effect on the younger age classes as girdling on the older age classes the combined result may be described as "burning the candle at both ends," and must merely accelerate the destruction of teak. We have ceased to make plantations, and as the final yield will not be available for many years, we cannot expect much help from the plantations already made. Other works are carried out on such a small scale that they cannot be expected materially to check the deterioration of the growing stock.

While reaping the gift of a bountiful Nature which has been so prodigal to us in Burma, and has without any merit or effort on our part given us, in teak, so great a source of wealth, we are, I think, taking inadequate measures to prevent the inevitable deterioration, and are remaining satisfied with a state of affairs which would be regrettable, even in a third-rate Native State.

H. C. WALKER.

*(To be continued.)*

## THE UNITED PROVINCES SHOOTING RULES.

A good deal has been written from time to time about the merits and demerits—chiefly the latter—of the U. P. shooting rules. The writers however have been mostly sportsmen outside the Department, so perhaps a few words on this subject from a Forest Officer's point of view may not be amiss.

The first point to discuss is the necessity of keeping correspondence on shooting matters within reasonable limits. In the division of which I have recently taken charge the correspondence dealing with shooting for the current season already amounts to 542 letters and telegrams, and this is further supplemented by the issue of shooting permits in triplicate, bungalow passes in duplicate, and the upkeep of a shooting register. All this the Forest Officer has to attend to personally. It takes up too much of his

time and other more important work must suffer in consequence. The task moreover is bound to be a thankless one inasmuch that for each shooting area that can be allotted to a sportsman or shooting party it is necessary to refuse a large number of applications.

Much ink is wasted owing to ignorance of, or non-compliance with, the rules and to lack of local knowledge. Probably every sportsman has a copy of the shooting rules somewhere, it is however easily mislaid, and even if at hand it gives him no information about local supplies and transport, etc., it does not tell him that treasuries refuse to accept private cheques in payment of shooting fees though this lack of information alone is answerable for many extra letters.

In order that applications for shooting blocks should be in order, why should not all essential information be printed on standard application forms: these forms to be supplied free by Forest Officers and their use made compulsory.

There seems to be no reason why replies to applications should not also be printed. They would be in book form adapted for carbon duplication.

The reply form would require a para. dealing with the refusal and another with the grant of a permit, one of which could be struck out as required; it would further contain details of fees for different classes of permits and other useful information similar but may be in more detail than that given in the application form. All items of information to be serially numbered for reference.

Something of this kind might do :—

I. (*a.*) A permit for Shooting Block . .........cannot be issued for the period applied for } except from ........to...... .. *vide* No. . .........

I. (*b.*) Shooting Block............ ..has been booked provisionally in your name from ...........to............and a permit will be issued provided the fees (calculated at Rs. 10 per gun and Re. 1 per diem per elephant) are received not later than........ If the fees are not received by this date other applications for the area will be considered.

(II) With regard to your further enquiries you are referred to No............

1 }
2 } List of important rules and useful information.
3 }
&c.

Another suggestion occurs to me for the relief of Divisional Officers from the work and worries connected with shooting, and that is the transference of all shooting correspondence for the Circle to the office of the Conservator who would of course require a personal assistant or a thoroughly capable shooting clerk with honeyed tongue in order to deal with it. Perhaps it will be well not to harp on this suggestion—Conservators are sure to see nothing to recommend it.

Now I wish to draw attention to what has always struck me as a distinct hardship under the present rules and one deserving of redress. Formerly the Forest Officer, in addition to being *ex-officio* exempted, was entitled to have two guests with him. These accompanied him on his ordinary tour and took such shooting as came in their way. Nowadays however the Forest Officer has to choose between the following alternatives, namely, either not to ask friends to come and stay with him in camp or to reserve a shooting block in his own name and sit tight there while his friends get some shooting and while work in other parts of the division looks after itself. The third alternative, which is the only real solution of the difficulty, is for him to reserve several blocks for a few days each along the line of his intended tour. This method though admissible under the rules is probably never resorted to because each reservation of a block for a few days carries with it a further closure of 15 days at least and it would be manifestly unfair to others. In practice I believe Forest Officers do not often engage blocks for themselves and usually only shoot when they happen to be passing through an area under rest period. Under such circumstances however they are absolutely debarred from having friends with them. It is to be remembered that while for most other people the jungles are merely a place of

amusement and recreation the Forest Officer spends the whole season there at work. In consideration of this and the loneliness of his life the forest man might well be given back his old privilege of having at any time as many as two guests with him, who could shoot for the time being on the same terms as their host. As a set off against the reinstitution of this privilege the existing privilege of being able to reserve blocks in his own name might, if thought desirable, be rescinded except as regards the Christmas holidays. The general shooting public would benefit as a result of reduced competition for reservation of areas and to some extent as individual guests.

Now about annual permits. The fee of Rs. 100 is well enough for residents in a district with plenty of leisure to devote to shikar, but the fee is a very high one in the case of certain unexempted district officials for which this class of permit was, I think, primarily intended. Take for instance a Joint Magistrate whose cold weather touring takes him partly through reserved forest he has not much spare time for shikar but wants to be able to take an evening stroll with gun or rifle. He begins by taking out an annual permit and probably finds his bag at the end of the season consists of one or perhaps two chital stags and a few jungle fowl—one hundred rupees and perhaps not a trophy to show for it—it is not worth it. It pays him much better to enter into competition with the general public in booking shooting blocks for himself. He probably will not want to reserve more than four or five blocks altogether which will cost him forty to fifty rupees. The reservation of five blocks however taking rest periods into account results practically in the monopoly of about one-sixth of an ordinary forest division for a whole season. Special cases like the one just referred to surely call for special treatment and they might well be dealt with by the issue of annual permits to individuals by name either free or at reduced fees if approved by the Conservator and the Commissioner.

My concluding remarks will deal with the allotment of the areas for district and Christmas shoots. In most forest districts it is an old standing custom for the local officials to meet once a

year for a joint shoot in the reserves. The advantages of such a gathering as regards promotion of good fellowship and the clearing off of many vexed subjects that have got sticky with prolonged correspondence, it would be hard to over-estimate. The district shoot by rounding up all the local officials into one or at the outside two shooting blocks removes at any rate local competition for the time being from all other shooting blocks in the division, it therefore follows that this institution is to this extent beneficial to the general public as well. This being so the district shoot should receive an assured position and the Forest Officer should be empowered to allot a period and area to it irrespective of the three months' rule.

As regards allotment of shooting blocks at Christmas, long established custom gives precedence to local officials. This might be recognised in the rules by making such applications valid if submitted more than three months in advance.

Christmas shoots are generally on a large scale as regards *bandobast* and guests :—*Am*-shikar is usually the order of the day and the bag consists mostly of small game as the season of the year precludes anything in the way of a heavy bag of big game. The local officials from their position are best qualified to make such parties a success, and it is surely preferable that the applications of these who are capable of giving pleasure to a number of guests at this festive season should be given precedence to those of individuals who have not the same facility for doing so.

E. R. STEVENS.

## "VOCABULAIRE FORESTIER."

BY MESSRS. GERSCHEL AND FISHER.

The 5th edition of Professor Gerschel's "Vocabulaire Forestier" has just been published by the Clarendon Press, Oxford, and can now be obtained from the trade at the modest price of 5 shillings. In the Vocabulary equivalent Forest terms are given

in English, French and German, thus knowing any technical term in English, the reader can at once find its equivalent in both French and German. The volume was revised and corrected for the author by the late Mr. W. R. Fisher and possesses a melancholy interest in being the last piece of work that he put his hand to. We cordially recommend it to all foresters as a handy and useful publication. We print a translation of the preface as written by M. Gerschel :—

"The favourable welcome accorded to four successive editions of this Vocabulary affords me ground for thinking that this small work meets one of the wants of our time. Every forester who wishes to be acquainted with the works of his foreign colleagues—and the number is daily increasing—is glad to find in a small volume the exact translation of technical aud scientific terms employed in Forest Science. I have therefore gladly availed myself of the kindly offer made me by Mr. Fisher, the eminent Professor at Oxford University, and the delegates of the University Press, to participate in the publication of the 5th edition with a view to according an important place to Forest terms adopted in America and India where of late years the study of Forestry has so greatly developed. I trust that in its new shape the Vocabulary will continue to be welcomed as cordially as before and will assist in cementing friendly Forestry relations between different nations.

I will gratefully welcome all Forest terms which can be usefully inserted."

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## PYINGADO.

Mr. J. Nisbet, Dr. Œ, late Conservator of Forests in Burma, writes :—With regard to the note on Pyingado timber published on pages 178-179 of the *Indian Forester* for March and April, "the Burmese distinguish two kinds—Pyingado-*abo* (male) and Pyngado-*ama* (female), the *ama* being darker in colour, heavier, harder, and more durable. Unfortunately I have not Kurz, Gamble or Brandis' book at hand to refer to; but whether there be any recognised *botanical* distinctions between them, or whether the difference in the quality be due to soil, there is certainly a difference which is

sometimes very marked, and which I had good opportunities of seeing during 1882–86 when I ran a Pyingado saw-mill at Taikgyi (Rangoon Division) for converting railway sleepers."

## NOTE ON THE BEST SEASON FOR COLLECTING MYRABOLANS AS TANNING MATERIAL.

BY MR. PURAN SINGH, F.C.S., CHEMIST TO THE FOREST RESEARCH INSTITUTE.

It was proposed to examine the fruits of *Terminalia chebula* collected at different seasons from the same locality to determine the best time of year for collecting them so as to obtain the greatest yield of tannin. The Forest Chemist received the following specimens from the Deputy Conservator of Forests, South Thana, Bombay, collected in different seasons of the year and at different stages of their growth :—

| *No.* | *Description.* | *Date of collection.* |
|---|---|---|
| 1 | Half ripe myrabolans ... ... ... | 27th October 1910. |
| 2 | Nearly ripe do. ... ... ... | Do. |
| 3 | Quite ripe do. ... ... ... | Do. |
| 4 | Half ripe do. ... ... ... | 1st January 1911. |
| 5 | Nearly ripe do. ... ... ... | Do. |
| 6 | Perfectly ripe do. ... ... ... | Do. |
| 7 | Half ripe do. ... ... ... | 6th March 1911. |
| 8 | Quite ripe do. ... ... ... | Do. |
| 9 | Quite ripe and dried. do. ... ... ... | Do. |

The first three specimens were not very different in appearance and size, and of the others, the half ripe and nearly ripe specimens were nearly alike, while the ripe ones were larger in size and deeper in colour.

These nine specimens, after having extracted and rejected the kernels which contain no tannin, were reduced to a fine powder and were analysed under similar conditions. The results obtained are given in the table on the next page.

The tannin was estimated by the Nickel Hydroxide process proposed for the first time by the Forest Chemist. It consists in the use of freshly prepared Nickel Hydroxide (washed free of alkali and sulphates) in place of chromed hide powder.

| No. of sample. | Description of specimen. | Date of collection. | Proportion of pulp to kernel. | Moisture. | Ash. | Total soluble solids. | Tannin estimated by Nickel Hydroxide. | Non-tannin. |
|---|---|---|---|---|---|---|---|---|
| 1 | Half ripe myrabolans ... | 27-10-10 | 1·5 : 1 | 9·12 | 3·59 | 62·08 | 43·98 | 18·10 |
| 4 | Do. do. ... | 1-1-11 | 1·88 : 1 | 8·59 | 3·92 | 66·64 | 49·84 | 16·8 |
| 7 | Do. do. ... | 6-3-11 | 2 : 1 | 9·26 | 3·48 | 67·16 | 52·96 | 14·2 |
| 2 | Nearly ripe do. ... | 27-10-10 | 1·53 : 1 | 9·06 | 3·60 | 60·00 | 41·60 | 18·4 |
| 5 | Do. do. ... | 1-1-11 | 1·89 : 1 | 8·59 | 4·11 | 65·00 | 46·5 | 18·5 |
| 8 | Quite ripe do. ... | 6-3-11 | 2 : 1 | 9·00 | 3·46 | 65·88 | 49·88 | 16·0 |
| 3 | Do. do. ... | 27-10-10 | 1·67 : 1 | 9·61 | 3·43 | 63·96 | 48·01 | 15·95 |
| 6 | Perfectly ripe do. ... | 1-1-11 | 2 : 1 | 9·34 | 3·84 | 63·94 | 50·39 | 13·55 |
| 9 | Quite ripe and do. dried. ... | 6-3-11 | 2 : 1 | 8·75 | 3·61 | 66·88 | 51·68 | 15·20 |

From the foregoing table it will be seen that the ash in all the samples is nearly the same, being a trifle more in the unripe fruits. In fully ripe fruits collected in November, January and March respectively, the proportion of pulp to kernel increases from 1·67 to 2 : 1, while in half ripe fruits it increases from 1·5 : 1 to 2 : 1 for the same period, and in the so-called ripe fruits, it also increases from 1·53 : 1 to 2 : 1.

As for the tannin value, it ranges between 44 per cent to 53 per cent from October to March in half ripe fruits and between 42 per cent to 50 per cent in nearly ripe fruits and between 48 per cent to 52 per cent in ripe fruits. From these results the writer is of opinion that the longer the fruit is allowed to remain on the tree, the higher is its tannin value, and it may be safely recommended that myrabolans should be collected when they are perfectly ripe.

Trotman in his Leather Trades Chemistry mentions that there are five chief varieties of chebulic myrabolans named after the district from which they come and that their price and value vary considerably. It is very difficult, if not impossible, to tell by inspection which are the richest in tannin.

Parker and Blochley (Collegium 1904, 101) have shown that often the hand-picked varieties, which fetch a higher price on the market, actually show less percentage of tannin than the cheaper varieties, and they prove that the colour of the fruits is no indication of their tannin value. They also state that the hand-picked samples are not only poorer in tannin but give darker solutions and leather of a deeper colour than the riper fruits. The writer has also noticed the dark colour of the solutions made from hal ripe myrabolans.

The hand-picked varieties are generally of a lighter colour and are apparently taken from the trees before they are quite ripe or they are sorted as being of a lighter colour.

The results given in this paper and the conclusions arrived at by Parker and Blochley go to show that the classification of myrabolans according to mercantile practice is erroneous. The fruits that have remained longest on the tree, *i.e.*, those quite ripe

should be classed as the richest in tannin, irrespective of their colour.

## TREE PLANTING IN HIGHLANDS.

A valuable report by Lord Lovat and Captain Stirling of Keir, which is likely to form the basis of a great afforestation scheme for Scotland, has been issued by the Royal Scottish Arboricultural Society.

The report declares: (1) that it is possible to create forests in the Highlands, even in districts where the economic conditions appear most adverse, without seriously impairing existing sources of wealth; (2) that afforested areas will, even in the early stages of the movement, lead to a great increase in employment and population; (3) that the actual work of planting can and ought to be cautiously begun as soon as the progress of the survey justifies the selections of definite areas.

The authors of the report endeavour to demonstrate that under afforestation a very much larger rural population would be maintained than under any of the existing systems of land utilisation. The report is of special value on account of the census revelations of a marked depopulation in the Highlands.—[*Daily Mail.*]

## THE WORLD'S FORESTS.

There are believed to be in the world something like 4,000,000,000 acres of forest land. Of this only about 750,000,000 acres are in Europe, 78 per cent of that area being in Russia, Finland, Norway, and Sweden; and we are fairly safe in assuming that the size and productive capacity of these forests, with a reservation in regard to Russia, are known with reasonable accuracy. There remains an estimated area of over 3,000,000,000

acres in the non-European countries, distributed by Mr. Zon as follows :—

*Extent of Forests in Countries Outside of Europe.*

| Country. | Forest area. |
|---|---|
| | Acres. |
| Asia :— | |
| Asiatic Russia ... ... ... ... ... | 348,030,000 |
| India (Schlich) ... ... ... ... ... | 149,000,000 |
| Ceylon ... ... ... ... ... | 6,762,88c |
| Japan ... ... ... ... ... | 57,718,410 |
| Philippines ... ... ... ... ... | 49,000,000 |
| Malay States ... ... ... ... ... | 101,560 |
| Straits Settlements ... ... ... ... | 88,320 |
| Cyprus ... ... ... ... ... | 448,000 |
| Australasia :— | |
| British Australasia ... ... ... ... ... | 126,720,000 |
| Java ... ... ... ... ... ... | 4,920,000 |
| Hawaiian Islands... ... ... ... ... | 1,224,992 |
| Africa :— | |
| Cape Colony, Natal, Swaziland and Transvaal ... ... | 640,502 |
| Mauritius ... ... ... ... ... | 87,680 |
| Madagascar ... ... ... ... ... | 25,000,000 |
| Barbary States ... ... ... ... ... | 9,526,865 |
| Central Africa ... ... ... ... ... | 224,000,000 |
| South America (tropic) ... ... ... ... | 528,000,000 |
| West Indies ... ... ... ... ... | 42,668,800 |
| North America :— | |
| Canada ... ... ... ... ... | 799,360,000 |
| Mexico ... ... ... ... ... | 25,000,000 |
| Alaska ... ... ... ... ... | 107,000,000 |
| *United States* ... ... ... ... ... | 545,000,000 |
| Total ... | 3,050,298,009 |

In regard to the above it must be remarked in the first place that an acre of forest is a term which has practically no significance. There are acres which bear 500,000 feet of merchantable timber and millions of other acres which bear none at all. Of the 799,000,000 acres credited to Canada it is extremely doubtful if two-thirds are of any commercial value as timber land, or if one-

half, or 400,000,000 acres carry any merchantable timber as the term is now understood. What the supposed area of 248,000,000 acres in Asiatic Russia, again, could be counted on to furnish to meet market requirements is a matter of pure guess-work. The 528,000,000 acres of tropical forest in South America, and the 224,000,000 acres in Central Africa, again, are commercially unknown quantities. The 107,000,000 acres in Alaska amount to little. On the other hand no allowance is made for the forest in any part of the Chinese Empire, or as will be noticed in many other countries.

We have, indeed, to recognise the fact that we are still profoundly ignorant of what the timber resources of the world amount to. Sweden and the Philippine Islands have almost precisely the same forest area, namely 49,000,000 acres. Over a period of five years, for which Mr. Zon gives figures, the Philippines imported an average of 16 million board feet of lumber a year. Sweden exported 1,784 millions and in doing so did not diminish its forest area, for, under careful forestry, the annual cut in the Swedish forest is less than the annual growth. Austria-Hungary, with a forest area less than that of Sweden, and practically identical with that of the West Indies, exports nearly 1,500 million feet a year, of a value of about £6,500,000. The important thing, then, is not the forest acreage of any country, but the quality of that acreage and the use which is being made of it; the extent to which the timber is being properly conserved so as to constitute a permanent source of supply.—[*Times.*]

## THE RUBBER MARKET.

The rubber market appears to be going from bad to worse. When the so-called boom was at its height the best quality of rubber reached the extravagant figure of 12*s.* per lb., whereas the price a short time before had been about 3*s.* 6*d.* On Wednesday this week hard fine on the spot was sold at 3*s.* 11*d.*, while soft fine was quoted at the same figure. As will be readily understood the market has not been improved by the rumours of difficulties

on the part of Mincing Lane speculators, nor by the doubt which has arisen whether those firms, which are said to be responsible for the holding off the market of over 8,000 tons of Para rubber, will be able, in face of the continued fall in value, to continue to hold over produce, the value of which, even at only 4*s.* per lb., amounts to just three and a half million pounds sterling, leaving quite out of the question the enormous loss which will have fallen on those interested in holding back this huge quantity of rubber. As was foretold in a previous issue of this journal, there has been a series of ups and downs in the rubber market, the price being one day lower, then rallying again, but always in the end reverting to the downward tendency, which has now for several months past dominated the rubber market. As far as can now be judged, the inexorable laws of supply and demand have asserted themselves, and will continue to do so. At the fancy price of 12*s.* per lb. everyone was naturally in a hurry to market as much rubber as possible, and, at the same time, the company promoter hastened to secure the golden harvest. At first everything went well, but the time came when rubber, so far from advancing further in price, commenced to decline, finishing on Wednesday, as has already been stated, at 3*s.* 11*d.* per lb. instead of 12*s.* With regard to rubber-producing companies, while the shares in the many "wild-cat" affairs—mostly with more or less unpronounceable names—have become practically valueless and wholly unsaleable, it may be noted that the shares in really good rubber companies have hardly fallen in value in the same proportion as the commodity itself. For instance, while rubber at 4*s.* per lb. is only at one-third of the price which prevailed when the boom was at its climax, the fall in value of the shares of good rubber companies has not in many instances receded more than 50 per cent from the highest figure; for instance, Bukit Rajah shares, which have stood as high as £24, were on Wednesday quoted at about £11; but even thus the fall in value is serious enough, especially for those who got in at the "top of the tide." Looking at all the facts of the case, it does not appear that there will be any further very serious fall in price of rubber in the immediate future; in fact, a

certain recovery in value may not be quite improbable; but in the long run it would appear nearly certain that the tendency of price will, on the whole, be still in a downward direction.—[*Pharmaceutical Journal.*]

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## EXAMINATION OF *STROBILANTHES* ENDS SENT FROM BOMBAY.

### NEW SOAP PERFUME.

The oil distilled from the flower-buds of *Strobilanthes lupulinus* has a very strong but decidedly pleasant odour, reminiscent of tarragon and lavender, and is suggested as a suitable perfume for soap. It has the following constants:—specific gravity, 0·9648; refractive index, 1·4688; optical rotation, 16·30; acid number, 1·7; ester number, 257. There is some little doubt as to the source from which the oil is derived, but it is probably from one of the two plants to which the name *Strobilanthes lupulinus* has been applied, but which is now called *S. dalzellii*. It is a coarse-growing, hairy plant, with glandular hairs, and is very common in the Ghauts near Bombay, where it grows almost to the exclusion of other plants.—[*Pharmaceutical Journal and Pharmacist.*]

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## OIL FROM CONES OF *PINUS EXCELSA* FROM JAUNSAR.

### EXTRACT FROM MESSRS. SCHIMMEL & CO.'S "SEMI-ANNUAL REPORT."

"*Oil of Pinus excelsa.*—A sample of oil distilled from the cones of *Pinus excelsa*, Wall. (N. O. Coniferæ), a tree known in India as 'Indian Blue Pine,' has been sent to us. The oil, which is locally known as 'Oil of Pine Cone,' was of a yellow colour and possessed the following constants:—density at 15° C., 0·8757; specific rotation, 32° 45′; index of refraction at 20° C., 1·47352; acid value, 0·5; ester value, 5·6 (corresponding to 2·0 per cent of Bormyl acetate), soluble in 5 vols. and more of 90 per cent alcohol."

## INDIAN TURPENTINE OIL.

We take the particulars below from the *Bulletin* of the Imperial Institute:—

Samples of turpentine oil were forwarded to the Imperial Institute by the Assistant Conservator of Forests at Naini Tal, United Provinces, in August 1910. The oil was stated to have been prepared at the Government turpentine oil distillery at Naini Tal, from the oleo-resin of the "chir" pine (*Pinus longifolia*), and it was desired to ascertain its value as compared with the turpentine oils of commerce.

The samples were two in number, marked "A" and "B." Each weighed 16 lbs. and consisted of colourless turpentine oil. The specific gravity and the rotatory power of the oils were as follows:—

| | A. | B. |
|---|---|---|
| Specific gravity at 15°/15° C. ... ... | 0·871 | 0·868 |
| Optical rotation in 100-mm. tube ... ... | −0° 45′ | −2° 10′ |

The samples were subjected to fractional distillation with the following results:—

| | A | | B | |
|---|---|---|---|---|
| | Percentage of total sample by volume. | Optical rotation in 100-mm. tube. | Percentage of total sample by volume. | Optical rotation in 100-mm. tube. |
| Fraction boiling at— | | | | |
| 165° C. or below ... | 1 | −9° 45′ | 1 | ... |
| 165° C. to 170° C. ... | 54 | −5° 15′ | 55 | −7° 15′ |
| 170° C. to 175° C. ... | 25 | +2° 0′ | 28 | +0° 20′ |
| 175° C. to 195° C. ... | 12 | +6° 35′ | 9 | +7° 5′ |
| Residue ... | 7 | +10° 45′ | 6 | +17° 25′ |

The above figures show that the present samples, yielding practically no distillate below 165° C., are quite different from American turpentine oil which should yield not less than 70 per cent by volume between 155° and 160° C. They are of the same nature as a sample of turpentine oil from *Pinus longifolia*

from the Jaunsar Division, United Provinces, previously examined at the Imperial Institute. One-third of the latter was laevo-pinene, boiling at 157° C., and having a rotatory power in a 100-mm. tube of —36° 30′, and two-thirds consisted of a mixture of sylvestrene and other high-boiling terpenes, with a boiling-point of 173° C. and rotatory power in a 100-mm. tube of £13°.

This oil most nearly resembles Russian turpentine oil among those on the English market, but the Russian product is very variable in composition, and in this respect the Indian oil would have an advantage. The following figures have been recorded for two samples of Commercial Russian oil :—

| | | I. | II. |
|---|---|---|---|
| Specific gravity at 15·5°/15·5°C. ... ... | | 0·866 | 0·884 |
| Optical rotation in 100-mm. tube ... ... | | +14°29′ | +16°20′ |
| Fraction boiling at— | | | |
| 145° to 160° C. | per cent. ... ... | 4 | 2 |
| 160° to 165° C. | ,, ... ... | 12 | 16 |
| 165° to 170° C. | ,, ... ... | 43 | 36 |
| 170° to 175° C. | ,, ... ... | 20 | 18 |
| 175° to 180° C. | ,, ... ... | 11 | 7 |
| 180° to 185° C. | ,, ... ... | 3 | 4 |
| 185° to 190° C. | ,, ... ... | 2 | 2 |

No. 1 was also found to contain some petroleum.

### COMMERCIAL VALUATION.

Samples of this Indian turpentine oil were submitted to a firm of importers and to a firm of varnish manufacturers. The importers stated that the odour of the oil differed from that of American turpentine oil, and that an expert to whom they submitted it without stating its origin considered it to be a mixture of French and Russian oils. They valued the product at £30 to £40 per ton in London (October 1910).

The manufacturers reported that the oil resembled Russian turpentine oil and would have a similar value, *i.e.*, about half that of American oil. They added that the present value of American oil was about £55 per ton in London (November 1910), and they did not see any reason to anticipate any fall in prices.

CONCLUSIONS.

This Indian turpentine oil could be used in place of Russian oil, which is widely employed for the cheaper grades of varnishes, for black lacquers, and for making certain disinfectants. Information has been asked for from India as to the possibility of developing an export trade in this product at the prices quoted above. Detailed information regarding the present and possible sources of supply of turpentine oil are given in this *Bulletin* (1906, 4, 215).—[*The Indian Trade Journal.*]

## INDIAN ROSIN.

A sample of rosin (colophony) was forwarded to the Imperial Institute for examination in June 1910 by the Imperial Forest Chemist at Dehra Dun, with a request that it might be examined and valued. The sample was labelled " Colophony prepared at Naini Tal by using crystalline alum for its clarification." It consisted of masses of transparent, pale brownish-yellow rosin, having the usual appearance and properties of rosin of good quality.

It gave the following results on analysis :—

| | |
|---|---|
| Moisture ... ... ... ... | 0·80 per cent. |
| Ash ... ... ... ... | 0·15 ,, |
| Melting point ... ... ... ... | 74°C. |
| Acid number* ... ... ... ... | 174 |
| Saponification number* ... ... ... | 184 |

The ash yielded by the rosin was a reddish-brown powder; the quantity obtained was insufficient for detailed examination.

The analytical results show that this rosin is of good quality. Samples were submitted to merchants, who valued it at £14 to £15 per ton in the United Kingdom, and to a firm of soap-makers who considered it to be worth £13 per ton. The current value of American rosin of similar colour and quality was £14 9s. per ton. The merchants stated that the present prices are abnormally high, and that £12 per ton could be regarded as a fair average price for this material.

The Indian colophony is said to be of much better quality than a sample examined at the Imperial Institute in 1909. (See *Selected*

*Report from the Imperial Institute*, Part II, Gums and Resins (Cd. 4971, p. 196). As explained in that report, the value of rosin depends primarily on its colour, provided that the composition of the material, as indicated by the usual constants is satisfactory. The present sample is not quite so pale as the best Bordeaux rosin, but it would be classed with the " water white " grades of American rosin. There is no doubt that Indian rosin of this quality would sell readily in the United Kingdom at good prices.—[*Indian Trade Journal.*]

## NEGLECTED INDUSTRIES.

India has frequently been reproached for not making sufficient use of her resources in bamboo and cane, while in other countries their applications are past counting. At the present time small cylindrical boxes are imported by the thousand for the transport of drugs and other goods in small bottles by post, and yet it has never occurred to an Indian to make such boxes out of the hollow canes that are so common in the country. There is a bamboo peculiar to Travancore and the surrounding districts that is at present used for "reepers" in roofs and for the stems of pipes for smoking which might find an extended use in many other directions. Its botanical name is *Ochlandra travancorica.* Its joints or nodes are about four feet apart and it is so nearly parallel that on a single length of four or five feet it is not easy at first sight to say which is the upper end. This cane is said to grow to a thickness of $1\frac{1}{2}$ inches; it is very light and strong and would make curtain poles superior to the ordinary bamboo. Cut into small lengths it makes a very convenient case for small bottles and other articles. The ends may be plugged with a short piece of the male bamboo or with plugs of cheap wood cut with a tubular saw. This cane makes the best of thermometer cases, and, if rubbed with heavy mineral oil, it is proof against the white-ant. This oil disappears from the surface but imparts such a bitter taste to the wood that no insect can eat it. No steam power is required for dealing with this cane. A wooden table and a fine toothed circular

saw with a chuck on the saw spindle to hold the tubular saws which are of various sizes, and are made from old cycle frame tubes and the casing tubes of electrical wire conduits, are only required. If ornamental plugs are required a common lathe may be added. The *Ochlandra* makes excellent rulers, plain rails and other articles that must be of parallel cylindrical shape, and it has been successfully used to construct speaking tubes.—[*Indian Textile Journal.*]

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## THE MOSQUITO PLANT.

### WHAT ARE THE FACTS?

It is impossible for any European to live in India for any length of time without becoming aware that there is vast lore, traditional but none the less valuable, that ascribes to certain plants and trees certain properties. Some perhaps are healing, others noxious to a degree; some are insecticides, while others exert a similar result for the good of man by relieving him of the unwelcome attention of insects, by possessing a particular attraction for them. The medical properties of

### THE NEEM TREE (MARGOSA)

are numerous, and we doubt if there is any other tree that has so many medicinal or antiseptic uses. Others are the pomegranate, the *babul*, the tamarind, the wood-apple and its cousin the *bael*, of Upper India. As insecticides there is a flagged plant in Northern India the inner and tender leaves of which have a peculiarly pungent odour which is fatal to fleas and such vermin. It has been stated, with what truth we do not know, that the principal ingredient in a well known insect powder is the plant known by the Tamils as *vasambu*. In Madras, when eye-flies are about, the servants, if allowed, will hang up in every room branches of the plant they know as the 'milk-hedge' while the leaves of the castor-plant and the variety of basil known as *tulsi* (*Ocymum sanctum*) have long been regarded by Indians as

SPECIFICS AGAINST MOSQUITOES.

About seven years ago, Major H D. Larrymore, R.A. (retired), now in the Political Service in Northern Nigeria, wrote to the *Times* calling attention to

THIS PARTICULAR VIRTUE

of this widely distributed plant, and his letter caused some discussion both in England and in India. The *pros* and *cons* of the question were very fully discussed in a series of letters which appeared in our columns. The mosquito malaria theory was then very much in men's minds, and everything that would aid in the campaign against the malaria-bearing moisquito was eagerly seized upon and tried. Major Larrymore gave his experience of the use of the plant in the malarial regions of West Africa. He and his wife, he said, kept themselves

IMMUNE FROM MALARIA

by planting round their bungalow hedges and plots of basil. Sir George Birdwood corroborated Major Larrymore's opinion, and said that the fact that the many varieties of basil were fatal to mosquitoes was known from time immemorial to the Hindus. He added :—" When the Victoria Gardens and Albert Museum were established in Bombay the men employed on these works were at first so pestered by mosquitoes and suffered so much from malarious fever that, on the recommendation of the Hindu Manager the whole boundary of the garden was planted with holy basil and any other basil at hand, on which the plague of mosquitoes was at once abated, and fever altogether disappeared from among the resident gardeners.......The site of the gardens had before been one of the worst malaria-stricken spots on the island of Bombay. No one in those days knew anything of the mosquito-malaria theory of to-day." Others who agreed with Major Larrymore were Sir W. Thiselton Dyer, the well-known Kew official, and Sir C. A. King-Harman, then Governor of Sierra Leone. But Dr. Prout, the Chief Medical Officer of that Colony, disagreed, and conducted what he considered was

AN INFALLIBLE EXPERIMENT

to prove that the practical experience of Major Larrymore and Sir George Birdwood was wrong. He constructed a cage with two compartments, connected by a passage, in one of which he placed a pot of basil and then admitted mosquitoes into the cage. Close observation showed him, he said, that the mosquitoes, instead of seeking the compartment in which there was no basil, were all found in the compartment in which the plant was. The *Times* accepted this as conclusive.

It is difficult, however, to damp

THE ARDOUR OF AN ENTHUSIAST.

Major Larrymore went quietly on his way, relying in a malarious country on a "proceeding which had clearly been found useless," to quote the words of the *Times*. He has now returned to the charge, and the same journal contains further letters on the subject. This time Major Larrymore adds to his own experience the testimony of the chemical laboratory at the Imperial Institute, where it has been discovered that the leaves of the basil from West Africa (*Ocymum viride*) contain an aromatic volatile oil 32 per cent of which is thymol, a well-known antiseptic and germicide, which, according to the English and American Pharmacopœia, is largely used for mosquito lotions. The indefatigable

SIR GEORGE BIRDWOOD

again supports him, with another instance from his long experience in India. He says that "the recognised comparative salubrity of the vicinage of the great temple of Vithoba, or Vishnu-Krishna, at Pandharpur, Deccan, is obviously due to the circumstance that the whole of the rich land immediately around this, the greatest of the Mahratta shrines, is religiously restricted—or was down to my time, 50 odd years ago—to the cultivation of the *tulsi*." Sir George Birdwood also calls attention to the existence of the plant in every Hindu household; but this is apparently for religious rather than for medicinal purposes, or to act as a "mosquitofuge." It is not only among the Hindus that the

SACRED AND SANATIVE PROPERTIES OF THE BASILS

have been recognised from ancient times, but even among the early Christians the plant had these virtues ascribed to it. Sir George Birdwood recalls the fact that the "tradition of the schismatic Greek Church is that the plant grew upon the grave of our Saviour; and that every year on the day of St. Basil the women take sprigs of the plant to their churches to be blessed by sprinkling holy water on them; and, returning to their homes with them, eat some of them with their husbands and children and the rest place about the house, in the belief that it will be freed from sickness and from moths and mice during the ensuing year." Some further scientific enquiry into the efficacy of the basil as an insecticide or mosquitofuge might be made and India is as good a place in which to make the trial as any other, as no less than twenty-eight different varieties of basil grow here, most if not all, of which are said to possess the qualities which are claimed for the *Ocymum viride* and *O. sanctum*, or the *tulsi*. As the *Indian Planters' Gazette*, received to-day, says: "When quinine and mosquito nets faint in the combat with malaria, it is the custom, after the manner of the old herbalists, to call in the aid of the wild things of the forest. Sunflower, castor-oil plants, casuarinas and eucalyptus all have an enthusiastic following." Perhaps some enthusiast will add the basils to the list.—[*M. Mail.*]

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## PROTECTION FROM THE SUN'S RAYS.

It has repeatedly been stated that the effects of a tropical sun in inducing sunstroke are due more to the chemical than to the heat rays, and therefore clothing lined with or made of a fabric of material which does not transmit the chemical rays has been recommended for wear in tropical climates. An experiment with orange-red underwear has been tried in the Philippines, and is recorded by Captain Phalen of the U. S. Army. No beneficial effect whatever was observed from the use of this clothing; on the contrary, it added to the burden of heat upon the system, and it is concluded that white or khaki clothing sufficiently excludes the chemical rays.—[*Philippine Journal of Science.*]

## IVORY.

In a paper read before the Hunterian Society, Mr. J. Bland-Sutton, F.R.C.S., gave some interesting fact regarding ivory and the ivory trade. The tusks of the elephant are the permanent upper incisor teeth, and are found on the largest scale in the *Elephas Africanus*. There is one tusk in the Natural History Museum which weighs 228 lbs., but from 50 to 100 lbs. is the usual weight in a full-grown bull. As in the case of human teeth, the tusk consists of pulp and dentine. Bullets and spear heads have sometimes been found embedded in solid ivory—once at least a bullet was found in a billiard ball—and the explanation is that they have entered the pulp within the head and become incapsuled there, and as the tusk has continued to grow from its socket the foreign body has become incorporated in the solid ivory or dentine which forms two-thirds of the length of the tusk. Natives of Africa sometimes kill elephants by dropping heavily-loaded spears into their brains from trees. In the Museum of the Royal College of Surgeons of England there is a portion of an elephant's tusk with an iron spear 7½ inches long and 1½ inches broad embedded in it. There was no external mark to indicate the presence of this object, and it is supposed that it was dropped into the pulp of the tusk from above. In consequence of the irritation caused by the presence of the foreign body, the hard material which forms around it differs from true ivory, and is known as secondary dentine. Bullets have been found much less frequently in ivory since the introduction of the rifle with high velocity ammunition. In 1826 an elephant belonging to a wild beast show at Exeter Change, off the Strand, became dangerous, and when a detachment of infantry was told off to kill him, 100 bullets were fired into him before he died. After death a large abscess was found at the root of one of his teeth and this was probably the cause of the trouble he gave his keepers. Small masses of secondary dentine, due to disease, which are occasionally found embedded in ivory, are known to the trade as "beans." On one occasion when a billiard ball received a smart stroke from a cue, a large core of secondary dentine as thick as a thumb,

which traversed the complete axis of the ball, fell out to the astonishment of the player. As "green" ivory shrinks more rapidly in width than in length, so that a billiard ball tends to become ovoid—the billiard ball is turned in the rough and then kept in a warm room at an equable temperature for two years, before it is turned true. The best and largest tusks come from Equatorial Africa, and the world's output comes to 500 to 600 tons annually. Ivory sales are held in London four times yearly. In Great Britain the best ivory is used for making billiard balls, but the largest tusks are bought for the American market, and 50 per cent of the ivory imported into America is used for piano keys. There is a demand in India for making bangles. The best tusks fetch in the open market £68 to £70 per cwt. Ivory when dry is brittle, tending to split in concentric layers, but the chips are sold at a good price, because when calcined in a close vessel they furnish a charcoal known as ivory black, which forms a pigment for oil and water colours and is also used as an ink for printing engravings. As recently as 1891 the traveller F. J. Jackson found places in Central Africa, off the trade routes, where a 16-pound tusk could be bought for six strings of beads, but bargains like this are now rare.—[*Indian Agriculturist.*]

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## DOMESTIC ANIMALS.

It is curious and somewhat humiliating to recall that civilised man has added scarcely one useful creature to the list of those which he inherited from its savage forefathers. Even for the few which have been introduced to Europe since prehistoric times as buffaloes, cats, poultry, no credit is due to him—they were tamed elsewhere. But all the earth has been explored in these days—new birds and beasts beyond counting have become familiar. It might have been assumed that in such a host many would be found worth domesticating. But it is not so apparently—of all these animals only zebras and ostriches have been turned to the service of man; and the latter can only be called tame in the sense that they do not fear human beings.

Everybody knows that our domestic animals descend from wild species, but (says Mr. F. Boyle writing in the *Cornhill Magazine*) we are apt to regard them as gifts of Nature; not quite unreasonably, for the pedigree is lost as a rule. That Europe received cats from Egypt is indisputable, but a late discovery suggests, not to say proves, that the credit of taming a beast peculiarly savage must be bestowed elsewhere. A papyrus of the eleventh or twelfth dynasty not less than 3000 B.C., mentions cats among the articles imported from Nubia. But Professor Owen demonstrated many years ago that the Egyptian animal could not descend from the Nubian wild species. Did those savages obtain the specimens they bartered to Egyptian from another people more distant? Doubtless cats were tamed by savages, whether in Egypt or elsewhere.

Darwin remarked in South America that the business of domesticating birds and animals captured is left to wild Indians; their settled kinsfolk cannot find the patience, unless in easy cases as fledgings taken from the nest. He learned also that the work is done especially by the women, their gentle perseverance succeeds in time. When a fierce creature can be persuaded to take food from the lips, it is nearly vanquished, and to effect this is the grand endeavour.

Dogs must be omitted; they form a subject infinitely too large—as large as anthropology. Professor Steenstrup of Copenhagen ingeniously proved that even the men of the Kjokkenmodden Age had dogs. He found no remains which could be distinguished from those of wolves. But in the rubbish heaps certain bones of wild cattle and deer are always missing. Pondering this fact, Steenstrup confined a number of dogs and gave them carcases; they promptly accounted for the missing bones. It is very unlikely that wolves would aways be on hand to consume them when the rubbish-heaps accumulated for generations.

Horses also must be treated with discretion, but a good many facts not generally known, though generally interesting, occur to mind. Wherever the horse came from, vast herds roamed the central plain of Europe after the Reindeer Age, and the inhabi-

tants lived on them mostly. We have even a contemporary drawing, scratched upon the bone, which represents two naked men with spears stalking a couple of horses. The Cave of Solutre in the Dordogne, Southern France, could scarcely accommodate more than half a dozen families however tightly packed. But the entrance was protected by two walls of horse-bones, one a hundred and fifty feet long, ten high, and twelve thick ; the other forty feet long and five high. M. Toussaint, who explored this remarkable shelter of primeval man, roughly computed the number of animals thus stacked as forty thousand.

So many in one spot could hardly have been tame ; and if they were a large proportion would be old. But everyone was quite young, many of them foals. Evidently they had been killed in the chase, cut up and brought home for eating. The horse is first seen on Egyptian monuments about 1600 B.C., harnessed to the chariot of the sun. We cannot believe that it was never ridden in the long ages that followed before the Assyrian conquest· But is there any sort of evidence ? The Bible knows nothing of horses until David's time. Certainly the animals was strangely slow in travelling westwards, for the Accads were acquainted with it at least a thousand years before. This fact alone would suggest that if any people used it for riding the example did not commend itself to their neighbours. But there is direct evidence.

The Assyrians must have perceived the value of cavalry at the very outset, for they were masters of war, and they did not lack horses. But the bas-reliefs recording the campaign of Shalmanesir in Elam always represent them fighting in chariots, while the enemy are mounted. Still, they did not profit by the lesson. M. Maspero states that Sennacherib was the first to put soldiers on horseback, and then only in the form of mounted archers—moreover, riding was still such a desperate enterprise that a footman ran alongside with his hand upon the bridle, in case of accidents, as the sculptures show.

It may be urged that if no additions of importance have been made to the list of animals domesticated in prehistoric time, the reason is that all which would repay the trouble were discovered

and annexed during that mysterious epoch. One hears people argue thus. But the proposition cannot be maintained. It is absurdly improbable to begin with, and, then, the denizen of the farmyard is the direct descendant of a wild species. Zoologists dispute over the parentage of all.—[*Indian Field.*]

VOLUME XXXVII NUMBER 10

# INDIAN FORESTER

*OCTOBER, 1911.*

## FOREST FLORA OF THE SIWALIK AND JAUNSAR FOREST DIVISIONS.

BY RAI BAHADUR UPENDRANATH KANJILAL, F.L.S. (SUPDT., GOVT. PRINTING, CALCUTTA, 1911).

*A Review.*

Also

*Suggestions regarding the Preparation of Indian Forest Floras.*

In the introduction to the *Forest Flora of the School Circle, N.-W. P.*, published in 1901 and of which a second edition has lately appeared under the title given at the head of this notice, Mr. Gamble wrote in the year 1899: "I am confident * * * that this Flora will prove valuable to many successive classes of Forest students and many successive Forest Officers, whose duties may call them to the beautiful forests of the Dun and the splendid scenery of the adjoining Himalayan Mountains." The experience gained in the last ten years has proved that Mr. Gamble's confidence regarding the practical utility of this book was amply justified and the writer, having taught Botany for some years to the Forest students at Dehra Dun, can personally testify to its great value in helping the students to quickly acquire a knowledge of

the names of the more important local forest species. On the exhaustion of the first edition, the immediate preparation of a second edition became essential, and we heartily congratulate the author on its appearance and on the production of a work of such obvious utility. It augurs well for the future of the Provincial Forest Service when we find one of its officers, not only capable of publishing a work of this description, but who has undertaken the same and carried it to a successful conclusion, as a labour of love, in the intervals of heavy routine duties, first as an Instructor at the Dehra Forest School and subsequently as a Divisional Forest Officer in Assam. We trust that many others will follow his example, and that they will enjoy more leisure and better facilities for botanical study than were available for the present author. A feature of the book is its modest price, Re. 1-14-0 for the public and Re. 1-4-0 for students, which places it within the easy reach of all.

Forest Floras may be roughly divided into two classes :—

(*a*) Those, the authors of which have not only carefully studied their plants in the forest, but who have been able to personally inspect the types, or co-types, and original descriptions, which are the authority for the various specific names and who have had the opportunity of examining series of herbarium specimens from localities not personally visited by them. On the basis of such work, independent judgment can be given on the question of the limits of the various species and the correct names of the same. Floras of this description may therefore be regarded as *original* works, and as an example of what is meant by this term, we may take the excellent *Forest Flora of Chota Nagpur* recently published by Mr. H. H. Haines.

(*b*) Floras, the authors of which have studied their plants more or less carefully in the forest, but who depend for their identifications mainly on the work of other botanists. Such books must be considered rather

as compilations than as original. In this sense Mr. Gamble, referring to the first edition of the book under review, says : "The book does not, of course, pretend to be original." If, from the strictly botanical point of view therefore, the Flora cannot be regarded as original, there is no doubt that the author as a rule knows his plants well and has included in his book a number of valuable and original observations.

The author has incorporated in the present edition various slight alterations and additions which have been brought to notice from time to time, but the revision has been carried out in a different province and without the benefits of a reference library or herbarium, consequently the general scope of the work remains practically identical with that of the first edition.

Had opportunity permitted, we think the scope of the book might have been usefully extended to include, as Mr. Haines has done, "all indigenous trees, shrubs and climbers, the principal economic herbs, and the most commonly cultivated trees and shrubs." This was the view adopted by the writer in 1904 regarding the scope of local Forest Floras.* In the present work, for instance, we find no mention of *Dioscorea*, of which there are several local species, or of such plants as *Callistemon* sp., *Swietenia macrophylla*, *Sterculia alata*, *Kigelia pinnata*, *Aleurites cordata*, *Pongamia glabra*, *Grevillea robusta*, *Duranta Plumieri*, *Beaumontia grandiflora*, *Tupidanthus calyptratus*, *Hamelia patens*, *Mussaenda*, *Antigonon leptopus* and various other interesting plants met with in the gardens and avenues of Dehra Dun. The indigenous shrubs *Lepidagathis cuspidata* and *Triumfetta pilosa*, and the climber *Paederia foetida* might also have been included.

The following points are perhaps worth noting :—

Page 40.—It is hardly correct to call the stigma subsessile in *Berberis coriaria*, Royle.

Page 111.—Of *Leea* "leaves dilated at base into a sheath." The description of the Flora of British India, I, 664,

* *Indian Forester*, Vol. XXX, p. 101.

"petiole dilated at base into sheathing stipules" seems preferable.

Page 128.—*Rhus succedanea* was found by the writer at Kulni in 1904 and Kathian in 1909.

Page 156.—*Pueraria tuberosa*. The vexillary stamen is often quite free.

Page 162.—*Dalbergia paniculata*. There is no authentic record of *Dalbergia paniculata*, Roxb., from the Siwaliks. The plant collected by Hearle in February 1883 is *Dalbergia lanceolaria*, Linn. This has been already pointed out by Colonel Prain in *Ann. Calc. X*, p. 93 (1905).

It is not correct to say that the leaves and pods of *Dalbergia paniculata*, Roxb., are "exactly like those of *Dalbergia lanceolaria*, Linn."

Page 164.—*Shuteria vestita*, var. *densiflora*, is found near Dehra, on Siwaliks and probably elsewhere in area.

Page 181.—*Albizzia Thompsoni* is described in *Indian Trees*, p. 271.

Page 206.—Of *Rhizophoraceæ* "*Seeds* exalbuminous." The seeds of *Carallia*, the only genus dealt with, are strongly albuminous.

Page 298.—*Rivea ornata*, var *Griffithii*=*Rivea Roxburghii*, Prain, occurs wild near Dehra and on Siwaliks, as an erect shrub.

Page 299.—*Lettsomia Thoms ni* occurs near Dehra (Bindal Nala).

Page 309.—*Adhatoda Vasica* s frequently found locally in xerophytic stations, *e.g.*, on bare shingle beds.

Page 423.—*Coix Lachryma-Jobi* occurs locally as a rule near water. The plant called *Sacchurum arundinaceum* Retz, is *Saccharum Munja*, Roxb, quite a distinct species.

Page 424.—*Anthistiria gigantea*. This is not the common "Spear-grass" of the plains, which is *Andropogon contortus*, a species which also occurs in the area.

The question of classification and arrangement of natural orders and families is one which frequently causes difficulties, and attention may be drawn to the following points :—

(*a*) The natural system of classification of course is supposed to be phylogenetic, *i.e.*, to indicate the line of descent and various relationships of plants. In the first place it must be recognised that no mere linear arrangement of plant groups can ever satisfactorily indicate the various cross-relationships which may exist between a single group and several others. In the second place it is, as a rule, impossible to *prove* indisputably that resemblances as regards certain characters really do indicate relationships of a particular degree and hence there is, so far as can be seen at present, always likely to be more or less considerable difference of opinion as to what is the most correct classification. When it is remembered that the species is the unit of our classification and that there is at present no accepted definition of what a species is, in consequence of which scarcely any two botanists are able to deal with any number of plant-forms without a difference of opinion arising as to what should constitute a species, there is no ground for surprise that differences exist as to the limits of groups which are built up of these species-units.

Until we have evolved a definition of a species which is practically universally acceptable and which will enable us to satisfactorily *prove* that doubtful groups are, or are not, good species, we cannot be sure that these units are of equal value, or that the constitution of the higher and larger groups is carried out on right lines. This clearer conception of species appears to be attainable by—

(1) a detailed study of plant-forms in the field where alone intermediate forms can be assigned their true value and where the connection between variations and

the oecological factors of the environment can be traced ;

(2) experimental cultures to test the effect of such environmental factors on plant variations ; and

(3) a better knowledge of the laws of heredity.

Thus, further considerable progress in natural classification appears to depend rather on work in the field and experimental garden than on herbarium work. The latter is, in fact, the pioneer responsible for the rough material which, however, can only be perfected by field-work. Dr. Otto Stapf has given his opinion clearly on this point, as follows, when speaking of the oil-grasses, and his remarks are equally applicable to a large proportion of our other species : " Moreover, certain questions, some of them of great theoretical and practical importance, can, at the herbarium table, only be approached by a method of inference. The conclusions arrived at in this way will carry more or less weight according to the number and precision of data which the specimens present. I have in view more particularly the question of " variability " on which so much depends for the correct co-ordination and subordination of forms. The notes we have on this point from collectors and others who have had opportunities of observing the oil-grasses in their natural stations or in cultivation are few and extremely meagre. Systematically conducted experiments there are none. When this is the case the taxonomist has generally to fall back on his 'tact' ; but valuable as this somewhat ill-definable quality in certain circumstances may be, conclusions based on it cannot be accepted as final so long as they have not been confirmed by extended and direct observation in the field and by experiment. Work of this kind must therefore necessarily be more or less incomplete and preliminary. Nevertheless, it is a *conditio sine qua non* for systematically conducted field-work and experiment. It provides field-workers with a starting basis and with the means of checking the identity of the plants under observation. In return it will no doubt one day receive its corrective from that quarter."* The same author then defines " the rational

* *Die Naturlichen Pflanzenfamilien*, Nachtrage, p. 341 (1897).

conception of the ultimate task of the taxonomist, namely, to classify, not the dry and dead specimens of a herbarium, but through them the infinite diversity of forms in which plant-life manifests itself."* It will be clear therefore that we are still a very, very long way from attaining a satisfactory phylogenetic classification.

(*b*) Altogether apart from the theoretical phylogenetic aspect of a natural system of classification, however, there is the question of its great practical value as an instrument which facilitates the identification of plants. Under a natural system plants are placed in groups according to the sum of their important characters and not because of any single striking resemblance, as is the case in an artificial system. The majority of the plants in a natural group, therefore, tend to have a strong general resemblance, acquaintance with which enables us to assign a plant to its correct group without depending solely on one character which may be difficult of appreciation or which may be absent in our specimen at the time of collection. Recognising, as we must, the great value of a natural classification for the purposes of identification, it is no less important to realise that, from this point of view, constant changes in classification are highly inadvisable. It is obvious, for instance, that a comprehensive scheme of natural classification can not be thoroughly understood and its value, as an instrument facilitating identification, cannot be fully realised, until an intimate knowledge has been acquired of representative plants of each group and this is a question of prolonged and careful study. Thus for this reason only, it is clearly inadvisable to change a carefully considered scheme which has been at all widely adopted, unless it can be replaced

* *The Oil-Grasses of India and Ceylon*, in Kew Bull. Miscell. Information No. 8, 1906, p. 299.

by one which is universally acknowledged to be greatly superior.

Whatever the respective merits of rival schemes of classification may be, also, there is no doubt that it is advantageous to adopt that scheme on which the majority of Floras have been based to which one must constantly refer.

The scheme of classification which for many years has been the standard adopted by the best English botanists is that of Hooker and Bentham's classical *Genera Plantarum* published 1862—1883. Although admittedly imperfect so far as a truly natural arrangement is concerned, as all such schemes must be, there is no doubt that it possesses great merits in the way of facilitating identification, merits which, on the whole, probably make it more useful for beginners than the rival scheme of Engler * which of recent years has been somewhat widely adopted. Moreover, the standard Flora in India is of course Hooker's *Flora of British India* (pub. 1872-1897) which is based strictly on the *Genera Plantarum* and following this also (except with reference to a few minor points) we have Brandis' *Indian Trees* (1906), Cooke's *Bombay Flora* (1901—1908), Duthie's *Flora of Upper Gangetic Plain* (1903), Prain's *Bengal Plants* (1903), Talbot's *Forest Flora* (1909), Collett's *Flora Simlensis* (1902), and the book now under review (1911). In addition to the various Kew Colonial Floras the following works, which are especially useful for Indian botanists, also follow the *Genera Plantarum* (1) *Flore Generale de l'Indo-Chine* by Lecomte (1907), and (2) *Mikrographie des Holzes* of trees of Java by Moll and Janssonius (1906).

In all works dealing with Indian Systematic Botany, therefore, it seems advisable to adhere as far as possible to the classification of the *Genera Plantarum*, irrespective of the fact that different schemes of classification may appear from time to time which embody the results of the most recent researches on the true relationships of plants.

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* l. c., p. 301.

The student of Indian botany should aim at ultimately acquiring a knowledge of the natural families dealt with in the Flora of British India. This, however, is obviously a matter of some difficulty inasmuch as some 173 families are included in that work. It is therefore advantageous for the student to combine the families into still larger groups termed natural orders. When a good knowledge of these orders has been obtained by means of typical selected families, we are provided with a skeleton framework which will help us to determine the family to which any plant included in the Flora of British India belongs. The author of the present book, appreciating the value of such grouping, has included in this edition a synopsis of the families dealt with, arranged under their natural orders, which constitutes an improvement on the 1st edition. We are glad to see that the arrangement of the *Genera Plantarum* has been very closely adhered to. *Moringaceæ* however has been included in *Sapindales*, it would probably be placed better in *Parietales*. It is perhaps advisable to break up the series of *Monochlamydeæ* and *Monocotyledons* of the *Genera Plantarum*, but if this is done, as is the case in the book under review, we should be guided, when delimiting the orders, by the ideas now generally accepted regarding the relationships of the families, so far as this is consistent with keeping fairly closely to the general sequence of families in the *Genera Plantarum*. Thus it is hardly advisable to include *Lauraceæ* and *Thymelæaceæ* in the same order, as has been done in the book under review. In this connection, it may be mentioned that a scheme of Natural Orders, illustrated by typical and important families, based on the *Genera Plantarum* and embracing the families included in the Flora of British India, is now being drawn up at Dehra Dun in connection with the preparation of an elementary Botany Manual.

In conclusion, a few remarks on the general question of the adequacy of the supply of our Forest Floras may not be out of place. In the first place we have, of course, Brandis' *Indian Trees*. The conditions under which this was written, however, necessitated the exclusion of many species which a Forest Officer ought to know; many plant-forms which have been included also are very imper-

fectly known and have not been adequately described or classified, while in the less known forests such as many of those of Burma and Assam, there are undoubtedly still a number of entirely new species, which have never been described. The author, however, expressly states that *Indian Trees* was written in the hope that it "might facilitate the preparation of local Forest Floras." So far as can be seen at present, however, Bombay is the only province which appears to have any immediate prospect of being supplied with an up-to-date Forest Flora (by Talbot). Moreover, there is little doubt that insufficient knowledge of the vegetation of our forests is, at present, responsible for a direct loss of revenue, inasmuch as, owing to local officers not knowing their plants, many economic questions are now being hampered by the lack of accurate information regarding the distribution of important species, information which governs the available quantity of commercial products obtained from them and the possibility of creating a trade-demand for the same. The question of systematically undertaking this work of studying and describing our forest vegetation in detail and of supplying adequate local floras is, in fact, one of urgent importance which should be seriously undertaken without delay.

" As regards the size and scope of Forest Floras there is considerable difference of opinion as will be seen from the following :—
"The opinion is sometimes expressed that local floras should be in the form of small compact hand-books suitable for carrying in the pocket for use in the field. Experience has however proved that these guides are not of much practical assistance to the ordinary student and can generally only be used by experts in systematic botany. As a matter of fact such guides or floras, owing to the difficulty found in identifying species by their aid, only serve to repel and discourage the ordinary inquirer. There can be little doubt that real knowledge of forest or other plants must be gained by a careful study and examination of freshly collected material or herbarium specimens indoors with the conveniences of books and means for the dissection of flowers and fruits conveniently at hand." *

* *Forest Flora*, by W. A. Talbot, Vol. I, 1909, Preface, p. i.

"A *local* forest flora should *be* a local flora and should not embrace at any rate more than one circle, if as much. A forest flora covering too great an area is not *now* called for, and loses value in many respects. It takes much longer to produce in the first instance, and when produced is probably less complete than if it dealt with a smaller area. It is no longer a pocket companion but a book usually left in the owner's tent when he is engaged in the forest. It becomes less easy to use, so that many are deterred from the labour of looking up their trees who would utilise a smaller work.*

This difference of opinion arises we believe from the common use of the word *flora* for what would be more correctly described as a *descriptive list*. The primary object of a *flora*, which should override such minor considerations as shape and size, must be to make correct identifications as easy and certain as possible under all circumstances. Attention must, for instance, be paid to characters which separate each species from all nearly allied plants and to characters which are likely to be useful in identifying incomplete specimens, or the actual plants themselves when growing in the forest at different seasons of the year. The descriptions therefore must be *detailed* and the imperfections of descriptions must be supplemented as far as possible by *illustrations*. If we recognise the advantage of such a book as most of us will who have, for instance, used the descriptions in Brandis' *Forest Flora of N.-W. and Central India*, or in Cooke's *Bombay Flora*, it follows that to write books of this description for small areas, such as a Conservator's Circle, will lead to great duplication of labour and unnecessary expenditure, inasmuch as one and the same species may occur in several Circles. Hence a forest flora should, we think, deal with an area of not less than a single province and which may often be advantageously extended. On the other hand, there is no doubt that, if we deal with a small area, where the number of species is limited, it is possible to provide for fairly correct identification (especially in the field) in the majority of cases by paying attention to the vernacular names and a few striking characters, and this we

* *Indian Forester*, Vol. XXXIII, p. 195, by H. H. H.

take to be the function of a *descriptive list*. A *list*, therefore, should be handy and of a convenient size to fit the pocket, but to insist on a *flora* being, say 6″ × 5″, reminds us of the Comptroller's directions to reduce the number of transfers among subordinates so that they might fit into his printed office-form ! At the same time if illustrations similar to those in *Indian Trees* or the *Flora Simlensis* are adopted, there is no reason why an adequate *Flora*, dealing with one or two provinces, should not be of a convenient and portable size.

Regarding the question of the method of preparation of these floras and lists it should be noted that—

(1) It is advisable to provide local Forest Officers in every Circle, as quickly as possible, with the means of identifying with fair accuracy at least all their more common and important species and thus to obtain fairly precise information regarding their distribution in Government forests and the supply of marketable products available from them.

(2) Useful Descriptive Lists can be quickly prepared for small areas and published at a very small cost, whereas the preparation of adequate Floras will require a longer time and their publication will be more costly. Hence it is inadvisable to undertake the preparation of a Flora until sufficient data have been accumulated to make it sufficiently complete to obviate the necessity of an early revision.

It is therefore suggested that the preparation of handy pocket lists should precede the writing of Floras and should be first undertaken. That a selected Forest Officer should be placed on special duty in each Conservator's Circle, who would be responsible for preparing the list for that Circle and who would pay special attention to (*a*) the vernacular names in use in each district, (*b*) useful field characters and sylvicultural characteristics, (*c*) the distribution of the more important species and the preparation of distribution-maps for the same, and (*d*) economic uses. Such an officer might well spend some weeks, in each year at Dehra Dun

where he would have the advantage of utilising the Botanical Laboratory, Library and Herbarium of the Research Institute and could work up his field results. Doubtful points and identifications necessitating a reference to original descriptions or type specimens not available at Dehra would be undertaken by the Forest Botanist, or submitted to expert botanists at Calcutta and Kew. Before commencing operations, also, the detailed lines of work adopted by these local officers might be fixed in consultation with the Forest Botanist, Sylviculturist, and Forest Economist, at Dehra Dun and such questions as the precise scope of each list, its size, the principles to be adopted in classifying species and varieties, in describing oecological types of vegetation, in compiling sylvicultural lists and in preparing distribution-maps might be fixed after discussion, and after reference when necessary to higher authority. The advantage of such centralisation would be that all work would be carried out on a uniform plan which would greatly increase the value of the results obtained for the purposes of comparison and as regards their utilisation for any more comprehensive work which might be undertaken, while, botanically, the species described would be of approximately equal value. It is believed that, in most circles, two years' work would suffice for the preparation of a really useful and fairly complete list. Work, however, must not cease with such publication, but observations and inquiries must be steadily prosecuted and all additional information obtained, or corrections which seem advisable would issue annually in the form of an *addendum* to be incorporated in each copy of the List. The length of these annual *addenda* would clearly indicate when the time had arrived for undertaking the preparation of a detailed, illustrated Flora. The Lists would also to a great extent indicate the area with which each Flora would most conveniently deal, so that there should not be excessive duplication of descriptive work and so that the publication of a detailed account of the forest vegetation of areas which have been well explored should not be unnecessarily delayed. For the actual writing of the Floras officers might well be selected from those who had prepared the local Lists. Specimens of all plants collected.

and included in the Lists would be of course lodged in the Dehra Dun Herbarium, where they would be available for reference at the time of writing the Flora, while the notes and information collected regarding them from time to time would be filed in the Species-files of the Forest Research Institute at Dehra. It is possible that the local Circle-officers, while engaged on the Lists, might, so long as local research work is only undertaken on a small scale, be also usefully employed in carrying out and supervising the experiments and research work, which may have been commenced in each circle and which cannot be properly carried out by the Divisional Forest Officers with their heavy routine duties. The annual visit to the Research Institute would, in this respect, be of the greatest utility and would maintain close touch and co-operation between local research and the Central Institute at Dehra. While preparing the Lists, care should be taken to collect wood specimens of all named species from the identical individual trees from which the botanical specimens had been taken. The splendid wood collection at Dehra could be thus extended and Gamble's Manual could be kept complete and up to date while, for every wood specimen, there would be an authentic botanical specimen available for reference in the Dehra Herbarium. Among the advantages of the procedure suggested above are :—

(1) The provision for the collection of *complete* and authentic materials before the writing of a detailed Flora is attempted.

(2) Provision for the early supply of useful Lists for all Conservators' Circles and for the early publication of all subsequent information as it becomes available in the form of *addenda* to the Lists.

(3) Provision for the preparation of Floras by men who have made a careful study in the field of the vegetation of their particular locality for several years.

(4) Provision for giving the Forest Botanist opportunity of carrying out his special work as regards the study of the physiology, œcology and pathology of our important trees, in addition to the taxonomic study

of a few groups of economic importance which cannot be adequately dealt with without field study and of which the existing classification is unsatisfactory and confusing. If the Lists and Floras had to be prepared by the Forest Botanist his time would necessarily be entirely occupied with systematic work alone.

It may be urged that local officers can quite well prepare the Lists and write the Floras in addition to their own duties, but experience in the past shows that this is not a satisfactory procedure. In 1905 the writer drew up a preliminary List for the Northern Circle, Central Provinces. This List was compiled almost entirely from data collected in a single division of which the writer held charge and without the co-operation of officers serving in the other divisions of the circle, which the writer had been unable to visit. The object of the List as clearly explained in the *Introduction* * was to enlist the help of such officers and to obtain specimens and notes from them with the object of gradually compiling a complete Circle List, and it was proposed "to publish and circulate to all Forest Officers in the Circle who take an interest in the matter, yearly on the 1st July, an *addendum* to the List, embodying the corrections and additions which the past year's work had rendered necessary." Unfortunately the writer was transferred and after the publication of the incomplete preliminary List with one *addendum*, no further steps were taken to issue subsequent *addenda*.

In 1908 Mr. D. O. Witt, after two years' work with the co-operation of other officers in the Circle, was able to issue a list for the Berar Circle of the same Provinces which, although more complete than the List for the Northern Circle, is probably still far from complete, and no provision appears to have been made for the collection or publication of additional information. For the work to be thoroughly and quickly done it is essential that officers should be placed on special duty for it.

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* *List of Trees, Shrubs and Climbers found in the Northern Forest Circle of the Central Provinces*, Allahabad, Pioneer Press, 1906.

The Circle Lists it is suggested should not exceed a size of $4\frac{1}{2}'' \times 6\frac{1}{4}''$, they should, we think, ultimately aim at containing when complete a brief description of the locality and types of vegetation, a few important "sylvicultural lists" *, botanical keys to the natural families, genera, and species, a key to the local woods, *and distribution-maps of the principal species. For each species* would be given the vernacular names in use in each separate district, or division, of the circle, short notes on distribution, field characters and periodicity, such as will often suffice in the locality in question, when taken in combination with the vernacular names, for the identification of the plant in the field, and short notes on economic uses. The botanical keys, the key to the woods, sylvicultural lists, maps and descriptions of the locality and vegetation would probably be best added, only when it was considered that the list of species had become complete.

Finally when lists, such as are above suggested, have been completed, and have in their turn led up to the preparation of detailed, illustrated, local Floras, it may perhaps be possible and advisable to prepare one complete Forest Flora for the Indian Empire on the lines of some of the best European Forest Floras and where, in one place, for convenient reference, would be found all the important information available regarding each species.†

Much that has been written above deals with questions of a controversial character and we shall welcome the opinions of all those who take an interest in the subject.

R. S. HOLE,
*Forest Botanist.*

## SYLVICULTURE IN BURMA—PART II.

I have endeavoured to show that there is some room for improvement in our sylvicultural work, and I will now attempt to show what I consider should be done.

In order to determine what is the most suitable treatment, it is, I think, essential to ascertain how the growing stock is

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* *Indian Forester*, Vol. XXX, pp. 97-100.

† *See Indian Trees*, Introduction, p. vii.

constituted, and I think we may at once be certain of a number of useful facts on the grounds that, in spite of a certain amount of exploitation, our forests may be said to be the result of an unrestricted struggle for existence. At first sight the result would appear to be a bewildering medley of growth of every possible species and size, but actually quite a number of useful inferences can be drawn. For instance, we are safe in assuming that the distribution of a species such as teak must vary according to the suitability or otherwise of the conditions. Thus if we wish to know how the rainfall affects teak we can without hesitation, judging from the distribution of teak, infer that the rainfall is evidently favourable in Tharrawaddy, deficient in Thayetmyo, and excessive in Rangoon. Similarly, we can determine what soils are favourable, or the reverse.

For my purpose it is only necessary to make use of two or three facts and of the conclusions which, I think, logically follow from them. In the first place, each species in these forests must be maintained in a state of balance or equilibrium, and therefore we may base our calculations on the fact that in any working circle we must have a fixed and definite growing stock of teak, which will not fluctuate or vary except as the result of exploitation and sylvicultural operations. The effect of exploitation is, I think, sometimes misunderstood. Exploitation results in the disappearance of trees above 7 feet in girth (the minimum girdling limit) and the removal of a large proportion of seed-bearers places teak at a disadvantage with other species which are not touched, and therefore has a prejudicial effect on natural reproduction, but exploitation leaves the existing growing stock ranging up to a girth of 7 feet absolutely intact, and it is only this part of the growing stock which greatly concerns us in making calculations of the future outturn.

We also know that every species must display a tendency to increase. Teak produces sufficient seed to regenerate every acre in a short space of time, and statistics in working plans prove that there is a great predominance in the younger age classes. Teak may therefore be said to be striving its utmost to increase

in numbers, but in nature great destruction takes place, and as an equilibrium is maintained, it follows that the tendency to increase must be *exactly* counter-balanced by mortality. We have therefore an extremely simple method of calculating the mortality. If the growing stock is arranged in equal periods the natural mortality must be the amount by which one age gradation exceeds the next.

It is well known that in the human race these rates of mortality are constant and unfluctuating, in fact the whole system of insurance is based on this principle, and the saying, "Natura non facit saltum," suggests that the same uniformity is found throughout nature. In an ordinary teak and bamboo forest it is probable that great mortality takes place among the teak saplings at the time when they attain the height of the bamboo canopy, but each succeeding generation would have to meet the same condition and therefore we can understand that the mortality at the same stages must be similar. It is indeed generally admitted that the action and reaction of one species with another produces a state of great stability, and I think, therefore, we may assume that the ratios of mortality, obtained in the manner described, are suitable for the purposes of calculation.

From the statistics given in the Working-Plans, I have calculated what is approximately the growing stock of teak on 100 square miles of typical teak forest on the Pegu Yomas, as follows:—

| | Girth in forest. | Corresponding age. | Number of sound green teak trees. | Number of years to pass through class. |
|---|---|---|---|---|
| I | over 7 ... | over 150 ... | 23,317 | |
| II | 6 to 7 ... | 123—150 ... | 15,228 | 27 |
| III | 4½ to 6 ... | 89—123 ... | 29,544 | 34 |
| IV | 3 to 4½ ... | 61—89 ... | 42,300 | 29 |
| V | under 3 ... | under 60 ... | 269,114 | 60 |
| | | | 379,503 | 150 |

The general principle on which working-plans in Burma are based is roughly to go over each forest in thirty years, and to extract all trees over 7 feet in girth. In order, therefore, to show what is available for future yields, it is necessary to arrange the growing stock in age gradations of thirty years. The data given is not sufficient for the purpose of making precise calculations, but the figures given in the following table are, I think, fairly reasonable, and give a fair and clear idea how a typical growing stock of teak is constituted. I may explain that as no rates of growth are given for trees over 7 feet in girth, I have worked out percentages from girdling reports where one foot classes are given, and for the sake of simplicity have assumed that a foot in girth corresponds to thirty years' growth. I have assumed also that a tree is worth Rs. 45 at maturity and have calculated the present value at 5 per cent interest. The natural normal mortality I have calculated as explained above by subtracting one age class from the next lower class.

| | Corresponding girth in trees. | Number of sound green teak trees. | Present value per tree. | Natural Mortality in 30 Years. | | |
|---|---|---|---|---|---|---|
| | | | | Number of trees. | Present value. | Potential value at maturity. |
| | | | Rs. a. p. | | Rs. a. p. | Rs. a. p. |
| 391—420 | | 37 | | | | |
| 361—390 | | 131 | | | | |
| 331—360 | | 205 | | | | |
| 301—330 | | 382 | | | | |
| 271—300 | | 951 | | | | |
| 241—270 | | 1,567 | | | | |
| 211—240 | | 2,872 | | | | |
| 181—210 | | 5,920 | | | | |
| 151—180 | 7′ 0″—8′ 0″ | 11,252 | 45 0 0 | | | |
| 121—150 | 5′ 11″—7′ 0″ | 17,400 | 10 0 0 | 6,148 | 64,009 | 2,76,660 |
| 91—120 | 4′ 7″—5′ 11″ | 26,068 | 2 6 6 | 8,668 | 10,857 | 3,90,060 |
| 61—90 | 3′ 0″—4′ 7″ | 43,604 | 0 8 11 | 17,536 | 9,773 | 7,89,120 |
| 31—60 | 1′ 6″—3′ 0″ | 80,734 | 0 2 1 | 37,130 | 4,834 | 16,70,850 |
| 1—30 | 0″—1′ 6″ | 188,380 | 0 0 6 | 107,646 | 3,364 | 48,44,070 |
| | | 379,503 | | 177,128 | 92,837 | 79,70,760 |

According to these calculations out of 356,186 trees under 7 feet in girth, 177,128 trees are destroyed, even in a short period of

thirty years, and even at 5 per cent discount, which is a higher rate than is generally used in forest calculations, the value of the loss amounts to Rs. 92,837. It is obvious, therefore, that if we wish to increase the outturn, it is only necessary to reduce the natural mortality.

Before going into details, however, I wish to illustrate with these figures a few minor points. Assuming that the forest is gone over systematically in thirty years, it is evident that the yield will normally consist of trees ranging from 150 to 180 years of age. For the reasons given it may be assumed that, approximately, the same number of trees have always attained maturity in each period and will continue to do so naturally until the outturn reflects the prejudicial effect on reproduction of the removal of a large proportion of the seed-bearers. The natural normal yield can therefore be calculated very simply by determining how many trees have attained maturity during the previous thirty years, which in this case amounts to about 11,250 trees.

There are, however, altogether 23,317 trees over 7 feet in girth and therefore available for girdling, of which 12,065 are over mature and constitute a surplus. In no case, I believe, has it been arranged that the surplus should be spread over more than two periods, and in most cases it is to be removed entirely during the first period. In that case the yield for the first period would be 23,317, and for the second and subsequent periods only 11,250 trees of much smaller average volume. If the surplus is spread over two periods the fall in the outturn is not so great, but, however skilfully the yield is regulated, it is inevitable that so soon as the surplus is entirely removed there will be a considerable drop in the yield and a time of great scarcity. The object of sylviculture is, however, to counteract the prejudicial effects of exploitation, and it is indicated, therefore, that we should devote great attention to those trees which will be furnishing the yield at the time when the surplus will have finally disappeared. These now range from 60 to 120 years of age, and it may be seen that they are relatively few in number and as shown in the fourth column their value is comparatively high. Nevertheless we are at present doing little

or nothing for these trees, and for some reason or other are accustomed to attach *greater importance to reproduction. But* works, such as plantations, whath on sowings, dibblings, etc., even if successful, will not yield any result early enough to tide over the period of greatest scarcity, and, moreover, the potential rate of increase in the youngest age-classes is very great, and provided even a small proportion can be saved there should be no difficulty in increasing the yield later on.

It is difficult to realise how great the destruction is in a natural forest, and I have therefore put forward statistics, based on actual valuations, in order to illustrate this point more clearly. I have suggested that there can be no more effective way of improving the outturn than by reducing the natural mortality to which the species we desire to favour are liable, and instead of waiting a hundred years or so before our work produces any effect, there would be the further advantage that the effect on the yield would be almost immediate. It therefore behoves us to ascertain to what this natural mortality is due, and whether it can in any way be prevented. On this point there can, I think, be no difference of opinion. The mortality is undoubtedly due to mutual destruction caused by growth. In an even aged plantation of 1,500 or so plants put down per acre, there is no room for more than 50 or 60 at maturity, and in an uneven aged wood, as each acre is naturally stocked to its utmost holding capacity, it cannot be doubted that similar mortality results. The remedy is simple. Our forests should be gone over systematically, and wherever a tree or sapling of a valuable species, such as teak, is found suppressed, it should be freed by cutting back the less valuable and generally worthless species, and be given room for development. The work is commonly known as improvement fellings, and my object is to prove that they should be carried out more systematically

An important point to consider is to what extent other causes of mortality contribute. I have not the least doubt that here and there an odd tree gets burnt by annual fires, or is strangled by an epiphyte, or is blown over by the wind, but I consider other causes of mortality trivial in comparison. Our knowledge of the

diseases and causes of mortality in the animal world is, I think, misleading, but there are, I believe, few diseases which, like spike in sandal, can actually kill a tree. Teak requires moisture, a suitable soil and light. In most forests the moisture and soil are sufficiently favourable, and the only reason why pure forests of teak are not found, is because other species, equally well fitted for the struggle for life, prevent the reproduction and growth of the light loving teak. Thus in nature an enormous quantity of seed has to be distributed annually and for each tree a large number of seedlings have to be produced merely in order to maintain the existing stock and to prevent extermination, but when there is ample light, as, for instance, in making an avenue, one plant is all that is required.

Nature makes strenuous efforts to increase the stock of the species such as teak, but is defeated by the terrible waste and destruction, and it seems to me, therefore, that we have only to eliminate this destruction so far as possible, and to ensure that each teak tree shall have free access to the light and ample room for development, and we are bound to ensure a great increase in the growing stock.

The competition of other species is, however, not only responsible for most of the mortality, but also greatly retards the rate of growth, and therefore increases the length of time required to reach maturity. Every one knows what extremely rapid growth is put on by paddy-field teak on account of the free access to the light. Many instances could be given of the rapid growth of dominant trees in plantations. Still better evidence can be obtained by observing the rates of growth of the natural teak as evidenced by the annual rings. An examination of these rings almost invariably shows that, although the tree has survived to maturity, yet the contraction of the rings shows that at times growth has been exceedingly slow, and that the tree has had a desperate struggle for existence. Similarly the statistics of the rates of growth given in the working-plans show that in some trees the growth has been slow at one stage, and in other trees at another stage, and varies in such a way as to prove that the length of time for the average tree to

attain maturity has been greatly retarded. Although teak is capable, especially when young, of enduring considerable shade, yet it is well known that it is extraordinarily responsive to light, and I think, therefore, I am justified in assuming for purposes of calculation that the systematic felling of teak would reduce the time taken for the average tree to reach maturity from 150 to 100 years.

A further matter has, however, to be taken into consideration, namely, that owing to suppression a large proportion of the natural teak is twisted or kinked or deformed in some way, and that on that account the value of the timber is materially reduced. When girdling, one can often see the reason why in so many cases the teak is one-sided or forked, or straight up to a certain point and then bent over, and it is in fact extremely rare to find a perfectly shaped tree. Suppression greatly increases the susceptibility of a tree to fire. I think there would be some difficulty in finding an authentic case of a healthy teak tree which has always had free access to the light having been destroyed by light leaf fires, and I am convinced that systematic improvement fellings would by increasing the vitality enable teak to offer such resistance to these fires as to reduce the damage to a minimum.

The question arises what rotation should we endeavour to work up to. The necessity of giving tree-growth room for development is not confined to Burma. Elsewhere this work is not neglected, and the usual practice is to go over each wood thoroughly, once in ten years. Growth is, however, perhaps faster here than in most temperate countries, and in particular bamboo, when cut back, springs up again very rapidly, but a shorter rotation is impracticable. On the other hand, teak is capable of enduring a considerable amount of shade. I have, for instance, seen seedlings 30'or 40 years of age, stunted but still alive under a dense shade of bamboo, and in plantations it may be noticed for what a long time trees entirely suppressed can keep alive. A shorter rotation is therefore, I think, not necessary; I would therefore fix a rotation of ten years with the usual reservation that a shorter rotation would be preferable.

As regards the cost of these works. According to the statistics given in last year's Administration Report, the average cost per acre worked out to Re. 0-8-8. There seems to be an impression, however, that this cost is too low, and that the work is not properly carried out. In the table given the figures have been derived from the finest teak forests on the Pegu Yomas and are probably much above the average, yet the average number of teak, big, small and medium, only amounts to 6 trees per acre. It must be remembered that a proportion of these would struggle through to maturity, *i.e.*, 150 years, without any assistance at all, and if the forests were gone over systematically every ten years, the majority would certainly not require assistance every time. I think, therefore, that we may reckon that Re. 1 is an outside estimate of the cost of this work. At this rate the cost of operating over 100 square miles of forest on a rotation of ten years would be Rs. 6,400 per annum, or Rs. 1,92,000 for each period of thirty years.

We have therefore all the data we require for estimating the results which may be expected.

Assuming that the surplus is entirely removed during the first period, the second and the subsequent yields would be derived entirely from the stock at present under 150 years of age which for convenience is again given below :—

| Age. | Corresponding girth. | Number of trees |
|---|---|---|
| 120—150 | 5′ 11″—7′ 0″ | 17,400 |
| 91—120 | 4′ 7″—5′ 11″ | 26,068 |
| 61—90 | 3′ 0″—4′ 7″ | 43,604 |
| 31—60 | 1′ 6″—3′ 0″ | 80,734 |
| 1—30 | 0—1′ 6″ | 188,380 |
| | | 356,186 |

Assuming, therefore, that by means of systematic improvement felling carried out on a rotation of ten years, all mortality could be entirely eliminated and that the time taken to reach maturity could be reduced from 150 to 100 years the following results would be obtained :—

| Period. | Present dimensions. | | Number of trees available. | Value at maturity. |
|---|---|---|---|---|
| | Age. | Girth. | | |
| | | | | Rs. |
| Second ... ... | 105—150 | 5′ 3″—7′ 0″ | 30,434 | 13,69,530 |
| Third ... ... | 60—105 | 3′ 0—5′ 3″ | 56,638 | 25,48,710 |
| Fourth ... ... | 15—60 | 9″—3′ 0″ | 174,924 | 78,71,580 |
| Part of fifth ... ... | 0—15 | 0—9″ | 94,190 | ... |
| | | | 356,186 | |

In order to ascertain the profit, it is necessary to deduct the cost of the work during each period, *i.e.*, Rs. 1,92,000, and also the value of the yield which would have been obtained even had no work been done, *i.e.*, 11,250 trees at Rs. 45 and possibly 6,000 dead and fallen trees at Rs. 30. Total to be deducted Rs. 8,78,250. If this is deducted from the value of the yield the balance shows the increased value due to improvement fellings and amounts

for the second period to Rs. 4,91,280;

for the third period to Rs. 16,60,460;

for the fourth period to Rs. 69,93,330.

It is improbable that all mortality could be eliminated as I have assumed, but on the other hand, I have made no allowance for the improved quality due to the prevention of faults caused by suppression. However, this estimate may be reduced very considerably according to individual opinion, and there would still be left a handsome margin of profit. With regard to subsequent yields the elimination of mortality would increase the

number of teak seed-bearers, and the cutting down of less valuable trees where interfering with the growth of teak would reduce the proportion of seed-bearers of worthless species. This would of course react favourably on the reproduction of teak and the stock would therefore continue to increase at a geometrical rate of progression until the forest became so stocked with teak that they interfered with the growth of each other. The stock of bamboo could, however, never be materially reduced, and therefore the tendency would be to attain a pure overwood of teak with an underwood of bamboo.

The estimates which I have given may be considered impossible, merely because they are so extraordinarily good. Many instances, however, could be given from natural history of the wonderful results obtained merely by removing the natural causes of mortality. Game preservation in England is based on this principle. Although an estate may support naturally only a few head of game, yet when the vermin are destroyed large bags may be obtained annually without depleting the stock. Many instances could be given of plants and trees which have spread over a continent in an incredibly short space of time, not because they produce more seed than indigenous species, but because owing to exceptionally favourable conditions mortality is slight. As abundance of food corresponds in the animal world to free access to light in the case of plants, it may be mentioned that in Burma a general flowering of bamboo is invariably followed by a plague of rats owing to the abundance of food. Even in the case of teak in Burma instances could be given showing how teak has benefited by the removal of other species. The Shwekyundaw plantation is a patch of pure teak in the Prome division and is known to many. The origin is said to have been that a local *nat* or wizard bewitched any person who cut a teak tree, and therefore this species was protected while owing to the local demand for fuel and timber other species were cut out. The consequence is that teak has grown up so densely as to present the appearance of a plantation. In the Rangoon Division, and possibly elsewhere where the demand for fuel is great, clumps of pure teak are found

in unclassed forest as the result of protection afforded by proscribing teak as a royal tree. The heavy cutting of bamboos in accessible areas has often been noted to have had a beneficial effect. In these cases the results have been brought about by chance, and it can hardly be doubted that operations intelligently carried out and restricted to those stems only which require assistance would have a still greater effect.

H. C. WALKER.

## NOTE ON THE BEST SEASON FOR COLLECTING MYROBALANS AS TANNING MATERIAL.

BY MR. PURAN SINGH, F.C.S., CHEMIST TO THE FOREST RESEARCH INSTITUTE.

It was proposed to examine the fruits of *Terminalia Chebula* collected at different seasons from the same locality to determine the best time of year for collecting them so as to obtain the greatest yield of tannin. The Forest Chemist received the following specimens from the Deputy Conservator of Forests, South Thana, Bombay, collected in different seasons of the year and at different stages of their growth :—

| No. | Description. | Date of collection. |
|---|---|---|
| 1 | Half ripe Myrobalans ... ... | 27th October 1910. |
| 2 | Nearly ripe Myrobalans ... ... | Do. |
| 3 | Quite ripe do. ... ... | Do. |
| 4 | Half ripe do. ... ... | 1st January 1911. |
| 5 | Nearly ripe do. ... ... | Do. |
| 6 | Perfectly ripe do. ... ... | Do. |
| 7 | Half ripe do. ... ... | 6th March 1911. |
| 8 | Quite ripe do. ... ... | Do. |
| 9 | Quite ripe and dried Myrobalans ... | Do. |

The first three specimens were not very different in appearance and size, and of the others, the half ripe and nearly ripe specimens were nearly alike, while the ripe ones were larger in size and deeper in colour.

These nine specimens, after having extracted and rejected the kernels which contain no tannin, were reduced to a fine powder and were analysed under similar conditions. The results obtained are given in the table on the next page.

The tannin was estimated by the Nickel Hydroxide process proposed for the first time by the Forest Chemist. It consists in the use of freshly-prepared Nickel Hydroxide (washed free of alkali and sulphates), in place of chromed hide powder. (See the writer's Note on the use of Nickel Hydroxide *in Tannin* Estimation).

| No. of Sample. | Description of Specimen. | Date of Collection. | Proportion of pulp to kernel. | Moisture. | Ash. | Total soluble solids. | Tannin estimated by Nickel Hydroxide. | Non-tannin. |
|---|---|---|---|---|---|---|---|---|
| 1 | Half ripe Myrobalans ... ... | 27-10-10 | 1.5 : 1 | 9.12 | 3.59 | 62.08 | 43.96 | 18.10 |
| 4 | Ditto ... ... ... | 1-1-11 | 1.88 : 1 | 8.59 | 3.92 | 66.64 | 49.84 | 16.8 |
| 7 | Ditto ... ... ... | 6-3-11 | 2 : 1 | 9.26 | 3.48 | 67.16 | 52.96 | 14.2 |
| 2 | Nearly ripe Myrobalans ... ... | 27-10-10 | 1.53 : 1 | 9.06 | 3.60 | 60.00 | 41.60 | 18.4 |
| 5 | Ditto ... ... ... | 1-1-11 | 1.89 : 1 | 8.59 | 4.11 | 65.00 | 46 5 | 18.5 |
| 8 | Quite ripe Myrobalans ... ... | 6-3-11 | 2 : 1 | 9.00 | 3.46 | 65.88 | 49.88 | 16.0 |
| 3 | Ditto ... ... ... | 27-10-10 | 1.67 : 1 | 9.61 | 3.43 | 63.96 | 48.01 | 15.95 |
| 6 | Perfectly ripe Myrobalans ... ... | 1-1-11 | 2 : 1 | 9.34 | 3.84 | 63.94 | 50.39 | 13.55 |
| 9 | Quite ripe and dried Myrobalans ... | 6-3-11 | 2 : 1 | 8.75 | 3.61 | 66.88 | 51.68 | 15.20 |

From the foregoing table it will be seen that the ash in all the samples is nearly the same, being a trifle more in the unripe fruits. In fully ripe fruits collected in November, January and March respectively, the proportion of pulp to kernel increases from 1·67 to 2 : 1, while in half ripe fruits it increases from 1·5 : 1 to 2 : 1 for the same period, and in the so-called ripe fruits, it also increases from 1·53 : 1 to 2 : 1.

As for the tannin value, it ranges between 44 per cent to 53 per cent. from October to March in half ripe fruits and between 42 per cent to 50 per cent in nearly ripe fruits and between 48 per cent. to 52 per cent. in ripe fruits. From these results, the writer is of opinion that the longer the fruit is allowed to remain *on the tree, the higher is its tannin value, and it may be safely* recommended that myrobalans should be collected when they are perfectly ripe.

Trotman in his Leather Trades Chemistry mentions that there are five chief varieties of chebulic myrobalans named after the district from which they come and that their price and value vary considerably. It is very difficult, if not impossible, to tell by inspection which are the richest in tannin. Parker and Blochley (Collegium, 1904, 101) have shown that often the hand-picked varieties which fetch a higher price on the market, actually show less percentage of tannin than the cheaper varieties, and they prove that the colour of the fruits is no indication of their tannin value. They also state that the hand-picked samples are not only poorer in tannin, but give darker solutions and leather of a deeper colour than the riper fruits. The writer has also noticed the dark colour *of the solutions much from half ripe myrobalans.*

The hand-picked varieties are generally of a lighter colour and are apparently taken from the trees before they are quite ripe or they are sorted as being of a lighter colour.

The results given in this paper and the conclusions arrived at by Parker and Blochley go to show that the classification of myrobalans according to mercantile practice is erroneous. The fruits that have remained longest on the tree, *i.e.*, those quite ripe, should be classed as the richest in tannin, irrespective of their colour.

## METHOD OF DISTINGUISHING POWELLISED AND THE UNPOWELLISED WOOD.

When the powellised and the unpowellised woods get mixed up, it is somewhat difficult to distinguish one from the other, especially after they have been weathered by prolonged exposure. On a reference from Mr. F. A. Leete, Divisional Forest Officer, Pyinmana, Burma, an enquiry was instituted by the Forest Chemist to find out a simple test to distinguish the treated from the untreated woods. No satisfactory test could, however, be laid down for want of information as to the nature of chemicals that are introduced into the wood during the process of powellisation. The Powell Wood Process Co., Bombay, was referred to, and a reply was received to the effect that a small quantity of arsenic enters into the composition of the powellising solution. This information has greatly simplified the work.

Small chips of the powellised woods of *Albizzia odoratissima, Dipterocarpus tuberculatus, Terminalia tomentosa* and *Careya arborea* were obtained from the Forest Economist and examined for arsenic. *Each one of them gave a distinct reaction for arsenic. Many* specimens of the untreated woods were examined, which of course gave no such reaction.

Thus, the presence of arsenic in a piece of wood taken from a number of mixed specimens of powellised and unpowellised pieces, indicates that it has been powellised. It must, however, be remembered that solutions other than that used in the powellising process may contain arsenic; therefore when a piece of wood shows an arsenic reaction it is not to be concluded at once that it has been powellised.

Ninety different specimens received from Mr. Leete, were examined by this test, thus distinguishing the powellised from the unpowellised.

The test for the presence of arsenic in the wood may be carried out as follows:—

Take 3·4 grams of finely-powdered wood under examination and digest it in a glass flask over a sand bath with strong *arsenic-free* Hydrochloric acid for about 4 minutes. Then add a few small

pieces of *arsenic-free* granulated zinc and cover the mouth of the flask with a piece of filter paper moistened with a solution of Mercuric chloride $(Hg. Cl)_2$.

The formation of a yellow spot on the filter paper, changing into brown and finally into black, indicates the presence of arsenic in the sample. The development of this characteristic yellow colour takes place in less than a minute and it changes into brown or black according to the quantity of arsenic present in the sample and the period of treatment.

In theory, the test given above is identical with Marsh's test. Hydrochloric acid extracts arsenic from the wood and holds it in solution. Hydrogen gas liberated by the action of zinc and Hydrochloric acid combines with arsenic in solution to form *arsine* gas. The latter acts on Mercuric chloride, giving the yellow colouration of $As\ H\ (Hg. Cl)_2$ and then developing the brown and the black of $As\ (Hg\ Cl)_3$ and $As_2\ Hg_3$, the three characteristic compounds of arsenic and mercuric chloride.

The test for arsenic in wood as given above is very simple and precise, requiring no elaborate apparatus. One determination takes about ten minutes altogether. It is hoped that this test may prove of some practical use to the Forest Officer in distinguishing his powellised wood from the unpowellised.

PURAN SINGH,
*Forest Chemist.*

## THE SORROWFUL FOREST OFFICER.

The bewildering display of erudition by ·Op in the July number of the *Indian Forester* makes one rub one's eyes, and despite the wealth of quotations from the fathers of Forestry in various languages, we are left with the idea that the author has let his theme run away with him, and instead of being supplied with practical advice for the year 1911, which would be received with all due humility, we are treated to a romance of the future after the manner of H. G. Wells. In those days shall the electric tramway and water-driven portable saw-mill flourish, no longer

shall the bee-hole borer be a burden, and the Accountant-General shall fail.

Surely 'Op does not look at Burmese forestry in the right light. Has progress been so slow and is the forester in Burma so ignorant and unpractical that he is to be benefited by nostrums compounded of hoary maxims culled from the scriptures of forestry? My friend the Ranger of Bequadrpore, by the way, respectfully suggests that if assorted languages are to be employed in future, Urdu may be one of them, so that the full beauty of gems from the old masters may be appreciated by all the readers of the departmental Journal.

The author's first point of attack is the absence of a well-defined arrangement to preserve all forests where preservation is essential on climatic or physical grounds. It is however a fact that in the hilly districts of Burma large areas of reserves have been made from which nothing of any importance is likely to be extracted for many years, and it is a fact that for a number of years past special officers have been sent out annually to examine and propose for reservation further large areas in those districts where they are most required. The work is being done gradually in the order of urgency, and the policy to be followed has been already sufficiently laid down. How Burma is to benefit by another elaborate minute on the lines of that already circulated by the Government of India is not clear, and it is probable, in the light of past experience, that the result will be but another addition to the already unwieldy collection of "Schemes." Have we not already produced schemes for roads, schemes for improvement fellings, schemes for buildings, until the annual report becomes a string of reasons why they have not been carried out?

What do we want with plans of management for "climatic" forests? Their preservation is rarely a matter of such urgency as in other parts of India, and when we have managed to induce the Government to spend a few thousand rupees on acquiring a useful piece of forest, why should we not be content to shut it up and leave it for the present? Nature will do all we want in time, and it is hard to see what work plans of management could prescribe.

of much importance beyond planting which is out of the question on a large scale under present conditions, when we have so much to do elsewhere. It is almost superfluous to point out that the energies of the Forest Department in this matter are actually confined to the preservation of forests in catchment areas and on steep slopes liable to erosion, whatever exalted remarks may be made by the Local Government about climate and rainfall.

On the question of shifting cultivation I am inclined to agree with 'Op and it is probably only a matter of time before Government will be obliged to stop it, and introduce the terraced hill cultivation that is universal on the lower hills of the Himalayas. Again however he leaves us for a flight on a Wells' aeroplane, spurning the useful and humble hill alder, which had the all-important merit of being introduced to cover bare slopes by the hill tribes themselves, for a galaxy of bacteria with imposing names.

When our author touches on forests which afford a supply of valuable timber for commercial purposes, he omits to remark that in 1910 every one of the subjects that he mentions was discussed by a large number of Forest Officers at the Conference of 1910, who then, in full appreciation of their own comparative ignorance, made suggestions and drew up rules of all kinds for the systemisation of the work, and are now awaiting encouragement from the Local Government in the shape of men and rupees.

We are next shocked by the statement (in italics) that there is no experimental forest garden, but no one who has been fortunate enough to serve in several divisions in Burma need worry about that. The numerous different types of forest can best be studied by the divisional officer when going round his forests, where he is likely to obtain far more valuable data than can be collected under the artificial conditions of a central experimental garden, where the factors of climate, and probably also elevation and soil, will be very limited. Careful selection and systematic measurement of sample plots, on the lines of those made by the Sylviculturist in the United Provinces, are however badly wanted, and it is perhaps not too much to hope that

Burma may have a Sylviculturist of her own at no very distant date.

When touching on working-plans our idealist puts aside the mature opinions of local officers for the abstract maxims of writers who obviously refer principally to artificial or European forests. Does the Burma Forest Officer think that a working-plan is necessary only when exploitation is contemplated? Assuredly not, but he knows that at present it is impossible to do more than work over with a view to improvement a small part of the valuable forests, in which as a matter of course exploitation is going on, and accordingly regards it as a waste of time to make working-plans for the less important areas where he is certain that the provisions of the working-plans will not be carried out, and prefers to leave the forests to themselves to improve, as they do if closed and protected. In none of even the best forests of Burma are the existing working-plans fully worked up to as yet. As for Adam Smith, if his spirit visited Tharrawaddy or Prome, it would not be to abuse any one for not working, but to wonder why we did not get more men and money to work with.

When discussing minor forests to be managed in the interests of the local population, 'Op makes a remark which is absolutely misleading. He says that neglect of professional exploitation, organised improvement and work of a similar nature is the reason for the undoubted dislike of the department felt by the mass of the people. Where the people do dislike the department the cause is simple, being nothing less than the preservation of the forests from careless destruction, and the consequent inconvenience felt by the destroyers, but to say that Forest Officers do not encourage local trade and work by villagers whenever they get the chance, is absolutely to misrepresent the present state of affairs. In many cases it is far truer to say that exploitation and improvement are delayed by the want of co-operation from the neighbouring villagers, who are too slack to take the money that is held out to them.

The last head of the indictment is want of co-ordination. If the author had read the proceedings of the Conference he could

hardly have written this, and after all there seems to be no particular reason why the Northern and Tenasserim Circles should work under one scheme for roads. As for schemes, we have lots of well thought-out schemes, and we do not want more; we only want to be left alone with men and money to carry them out. At one time we heard we were to have a professional Secretary, but we were not lucky enough to get him, so we must do the best we can for the present with such arrangements as have been made, and they do not work so badly after all. It has not been found difficult as a rule, we believe, to convince the layman that our schemes for improvement are sound, but the end of the whole matter is rupees. Trusting that some few of the nebulæ among which ·Op has been vaguely wandering have been dispelled, at the risk of being pitiful I beg to subscribe myself

ALWAYS MERRY AND BRIGHT.

## MECHANICAL ROAD TRANSPORT OF TIMBER.

An article on the above appeared in our March-April issue. Messrs. John Fowler & Co., of Canada Buildings, Hornby Road, Bombay, write to us to say that "all the plants mentioned in the concluding paragraph of the article were manufactured and supplied by this firm and are all of them giving the greatest satisfaction."

They are further prepared to give full particulars of this or similar plant, to furnish expert advice and, if necessary, to send an expert free of charge to inspect roads, etc., and to prepare estimates of capital cost and working expenses.

We understand that plant is supplied by them under European supervision, while European experts start the work, giving instruction to the local staff, and remain until they are satisfied that everything is in good working order and running smoothly.

## GAME PRESERVATION IN BURMA.

In the *Times* review of Major G. P. Evans' "Big Game Shooting in Upper Burma" the following paragraph occurs :—

"Nothing, however, but support can be given to his plea for stricter game-laws, especially for the better preservation of the *thamin* or brow-antlered deer, the typical stag of Burma. At present does are entirely protected, but there is no limit to the killing of stags and no license, and good heads are growing scarce in consequence."

During the Forest Conference held at Maymyo in June 1910 a resolution was unanimously passed by the Forest Officers assembled, who were collectively intimately acquainted with the conditions of the game in all the forests of Burma, stating that game needed more protection than is at present afforded under the existing forest rules and recommending that a limit be fixed for each species, which should not be exceeded by any sportsman during a single year. A list was drawn up suggesting the number of each species that might be shot under an annual permit, this was fully discussed, and due allowance was made for men who spent a great deal of time in the forests and would probably not be content with a single bison, and a single *saing* in a year. The proposed limit was 3 bison, 3 *saing*, 3 buffaloes, 1 rhinoceros, 6 *sambur*, 6 *thamin*, 6 hog deer, 2 *serow* 2 *goral*.

There is no legal difficulty in the way of getting these proposals made law, as the powers given to the Local Government by the Forest Act are sufficient, and rules are already in force by which females, and males out of season, are protected in both reserved and unclassed forests.

I have accordingly read with great disappointment the following sentence under *Game Preservation* in the official note on the results of the Conference :—" The draft rules proposed, which are mainly to regulate shooting on public forest land, would give much greater control to Conservators than is perhaps necessary at the present time, but in special cases, *e.g.*, where the extinction of any species is feared, representation might suitably be made to Government."

With all due respect I submit that this stultifies the recommendations of the Conference. Most of us have had experience of making representations to Government, whether suitably or not, and know what a weary business it is to convince the powers that alteration is necessary. In this case let us suppose that a man has been shooting in the division and has killed 6 or 8 *saing* or the same number of bison during the camping season. The heads may be all fairly decent trophies, and he may not have slain a cow, but it is more than he ought to have shot, and the chance of finding really good heads in that division is greatly reduced. One can imagine the difficulty in obtaining any ruling based on the above. A long correspondence would be a foregone conclusion and the wearied divisional officer would hesitate to embark on it. Most local officers will agree that the above is not an extreme case, and brow antlered and hog-deer have also been shot in batches from time to time by people who should have known better, when half of them should have been spared. When, however, no good is to be done except in small local areas, and that after a tiresome amount of letter-writing, we may take it for granted that matters will rest as they are and that representations will not be made. What can be the objection to a limit being enforced ? We are not going to interfere with the chastening of the comparatively small number of game animals that harry the villagers' crops, and it is probable that the officials of every other department, and nearly all non-officials, will be with us in the endeavours to protect the game.

Elephants, the most destructive animals in the country, may not be shot except when actually caught in the crops, which is of course very seldom.

Some eight or ten years ago a Burma Game Preservation Association was formed, but it seems to have died a natural death without accomplishing anything. Over the greater part of India the best part of the shooting is confined to the forest reserves, in which a prescribed area and period for the permit-holder, and a fixed number of animals that may be shot by him, are taken as a matter of course. In Burma this is not so, and once a permit

has been issued for reserved forests, the holder may shoot as many bison or *saing* bulls as he likes, and may remove a cart-load of deer horns and skins, as long as he leaves does and stags, hornless or in velvet, alone.

In unreserved forests the same animals with the same exceptions may be shot by the dozen without any permit, and every one knows that there have been some glaring cases of this in the dry zone and other parts of Burma.

It has been stated that the Government of India has now under consideration a game law for the whole of India, but it is probable that it will only empower Local Governments to make such local rules as may be necessary. All the power we want in Burma is already in the Forest Act, so let us use it.

B. S.

## BURMESE TAMALAN WOOD (*DALBERGIA OLIVERI*).

A consignment was sent to London recently and is described by the dealers who handled it as somewhat like a padauk of poor colour. The specimens sent were apparently not first class, but the dealers state that even if obtainable in large sizes and good condition, it has no specially attractive features to offset its hard nature, which will make it difficult to work. As we understand however that this wood can be obtained of very handsome grain, we hope that Forest Officers in Upper Burma will be able to collect good samples for seasoning and despatch to London so that it may have a fair trial.

## NEW GUINEA BIRDS.

A wonderful collection of the birds obtained on the expedition in the Snow Mountains of Dutch New Guinea is on view at the Natural History Museum, South Kensington. The explorers,

under the lead of Mr. Walter Goodfellow, landed on the south coast of the island in January 1910, and the majority of the members of the expedition have not yet returned. Many of the trophies obtained have not at present reached England, but the collection now shown comprises more specimens of the birds of New Guinea than have ever before come to Europe.

It would be impossible to imagine a more brilliant scheme of colour than is displayed in the plumage. Eleven species of birds of paradise are exhibited, including the *Xanthomelus ardens*. Two specimens of this rare bird are contained in a Dutch collection, and a portion of the skin of one is at Genoa, but it has never previously been seen in England. The best known English work on the birds of paradise represents them as having a black neck, and this flight of fancy of the artist for some time puzzled the explorers, who imagined that the red and yellow birds which they obtained were of an entirely new species. The adult males possess a wonderful crimson ruff round the neck, but no trace of black is to be seen in either male or female. A more common but far more gorgeous species is the bird of paradise of the mainland of New Guinea. Its yellow tail plumes, which are of considerable length, are worn in the head-dresses of the natives for spectacular effect during their dances which consist largely of wagging the head.

Two entirely new parrots, known as *Aprosmictus wilhelminæ* and *Cyclopsittacus godmani*, have been brought home, and there are also a number of specimens of the *Nasiterna vividipectus*, the smallest parrot on earth—a little creature less than half the size of a sparrow. Other interesting birds are the Goura pigeons—now growing scarce on account of the demand for their plumage in the European market—and some large nightjars, with great frog-mouths, known as the *Podargus papuensis* and the *Podargus ocellatus*—the latter being slightly the smaller kind. Amongst all these things which were strange and new it was remarkable to note a common English cuckoo, taken in New Guinea, and probably on its way to Australia.

A great collection of reptiles, fish, and insects is also being formed, and will eventually come to this country; whilst the

collection of plants is at present growing at Singapore. Many objects of great ethnological interest are also promised. The explorers report that many of the native tribes are living in the conditions of the stone age. They have never before seen steel axes or any kind of iron implement. Many drawings have been brought back of their stone weapons and primitive tools, and one represents a strange contrivance of bark which is used as a protection against rain, and has the appearance of a large hood worn close over the head and covering the body to the waist.

The expedition is now under the command of Captain Rawling, Mr. Goodfellow having returned along with Mr. G. C. Shortridge and brought the present collection.—*(Indian Field.)*

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## THE KAURI KINGS.

### WORLD'S OLDEST TREES.

The Kauri (*Agathis australis*), one of the kings of the world's forests, is disappearing. The fire has engulfed him, the ruthless axe has followed him with death in every blow. In all new lands the history of settlement is (says Mr. J. Barr, writing in the *Lone Hand*, of Australia) a record of reckless and short-sighted timber destruction, and probably of no part of the world is this truer than New Zealand. Add to this that the Kauri is found only in a small portion of the islands; that in more recent years the commercial demand for its wood has been constantly increasing; and that replanting for practical purposes is out of the question, owing to the hundreds of years that a tree takes to reach maturity.

Some of the specimens in the Auckland district are among the oldest trees on the earth, and were sturdy growths long before the Christian era, nevertheless, to-day they exhibit all the life and exuberance of early youth.

In the Mangatu Kauri Park (Northern Wairoa) there is a kauri 48ft. in circumference which experts declare to be considerably over 2,000 years old. New Zealand forests are usually of a mixed character, some one or two kinds of woods predominating to

a greater or less extent. Nevertheless, certain districts may be roughly defined according to the prevailing trees.

The Kauri district may be defined as that part of the dominion northward of a line drawn across the North Island from the top corner of the Bay of Plenty. In that long giraffe-neck area is the home of the Kauri. Sometimes only single trees are found; sometimes they occur in clumps; sometimes in great blocks almost to the exclusion of all other trees. No grander sight could be found than a great Kauri forest.

### MASSIVE TRUNKS.

Close together rise the massive trunks varying from 80ft. to 100ft., and upwards, and often 40ft. to 50ft. or 60ft. in circumference. In diameter the trunks average from 3ft. to 8ft., but specimens have been measured with a diameter of fully 22ft. Clear from the ground out of the carpet of delicate ferns and palm lilies, the trunks in their flaked grey bark rise from 50ft. to 80ft. before branching.

And, as a dome about a giant's avenue, the rigid deep green leaves almost shut out the sky. Little wonder that the Maori was a tree worshipper, reverencing the noble sons of Tanemahuta, the father of forests, who rent heaven from earth by pressing his head against the ground and thrusting up the sky. But sentiment has no place in commercialism, and it is safe to say that at the present rate of consumption there will be no Kauri milling left in the dominion in 15 years.

Despite the fact that there is not sufficient Kauri timber to serve the local market, and that, as a consequence, Oregon pine has had to be imported, there was exported from New Zealand in 1909 24,000,000 superficial feet of Kauri, valued at, approximatey, £150,000. Most of this was for Australia.

The timber is of the highest value, and combines a larger number of good qualities in a higher degree of perfection than any other pine timber in general use; for while of enormous strength it is of great durability and is as easily worked as the best Quebec yellow pine. Its relative strength, when compared with English oak, is as 892 to 1,000. Many logs are beautifully clouded,

feathered or mottled and are specially valued for ornamental cabinet work, panelling, etc., realising from £7 to £10 or more per 100ft. superficial. The ordinary timber is used for wharves, bridges, and constructive works generally; square piles, railway sleepers, shipbuilding, housebuilding, and similar purposes.

In the years long past, when Sydney was the headquarters of the whalers in the South Pacific, the Bay of Islands in the North Island of New Zealand was a regular place of call for Kauri spars; and, later, quite a fleet of famous Island schooners, such as the Annie Wilson and the Sybil, as well as the steamer Countess of Ranfurly (lost recently) were constructed of Kauri planks.—(*Times of India.*)

## WOOD PAVEMENTS.

We have been interviewed by Pandit Mahabir Missra of Monghyr, who is interested in bringing to notice a timber known as "Indian oak," which has rather a wide distribution over India and Burma and grows freely in the Monghyr district. From a very small specimen left at our office the timber appears to have a light attractive colour, fine, close grain and smooth surface. It also belongs to the soft variety of woods and would appear suitable to all industries in which such woods are employed. In Gamble's Manual of Indian Timbers we see it placed under the natural order "*Myrtaceæ*" and is named "*Barringtonia acutangula,*" being described as a moderate-sized ever green tree with wood white, shining, soft and evengrained, occurring in the sub-Himalayan tract from the Jumna eastwards; also in Oudh, Bengal, Central and South India, Ceylon and Burma. It is found in swampy situations and on the banks of streams. Gamble states that the wood is more durable than it seems at first sight, and is used for boat-building, well-work, carts, rice-pounding and cabinet-making. Its average weight is about 39lbs. per cubic foot, the co-efficient P varying from 315 to 863lbs. But its weight has really a very large range and P varies, we presume, with the weight. Mr. Troup, of the Forest Department, confirms Mr. Gamble's remarks on the timber,

and adds that it is also used for making agricultural implements and machinery. Judging from the sample we have seen, the wood appears suitable for lead pencils, for matches and for paper pulp, and most important of all, for street paving which, a consensus of opinion, shows demands not a hard but a fairly soft timber. As Pandit Mahabir Missra is offering to supply blocks for a small length of experimental road, paving, free of cost, to the Calcutta Municipal Corporation, it might be worth the while of the Corporation to accept the offer since, if the timber proves a success as a paving material, its cheapness and plentifulness might be able to keep imported timbers out of the field. We have asked Pandit Mahabir Missra to send to this office for inspection a somewhat large piece of the timber that its properties may be more fairly judged.—(*Indian Engineering*.)

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## *FICUS ELASTICA*, THE INDIGENOUS RUBBER TREE OF THE MIDDLE EAST.

### CONDEMNED AS WORTHLESS TO THE PLANTER.

The so-called india-rubber tree, *Ficus elastica*—the familiar "rubber " plant" of British greenhouses and of cottage windows of the poorer class of plant-lovers, who prize its substantial and ample oval, glossy, rich, dark-green leaves and bright red-pointed shoots—is the indigenous rubber tree of the Middle East, writes Prof. Robert Wallace in *The Times*. The Professor continues: It is liberally represented in the jungle growth of Sumatra, Java, Borneo, the Philippine Islands, the Malay Peninsula, Burma, Assam, Anam, and Southern China. In the warmer and more equable areas of these somewhat diversified regions—Assam and Sumatra, for example—this wild fig—first cousin to the banyan tree of India, *Ficus indicus*—grows with great rapidity and assumes large dimensions. There are two outstanding varieties with distinctive habits of growth designated *F.e. pendula* and *F.e. fastigiata*. In a state of nature, where it springs from small, insignificant seed, it assumes the habit of the banyan tree and from its branching limbs throws out descending air roots, which, on reaching the ground,

take root and rapidly grow into powerful trunks to support the central and older portion of the structure. The rate of growth gradually becomes less and the size of the tree much smaller as the Northern and Eastern regions of its habitat are reached. This is due to the serious checks to development that result from extended periodic drought and cold to poverty of soil and to the retardation of growth generally by cyclonic disturbances in those parts which suffer from the erstnamed typhoons of the China Seas. But while the strong winds destroy the fragile or brittle structures of the Para tree, *Hevea brasiliensis*, and the Ceara, *Manihot Glaziovii*, and, with other adverse climatic conditions, conspire to limit the growth of these cultivated species to regions south of the 13th or 14th parallel of North Latitude, they only check the development of the wild but hardy Ficus, whose boughs and stems bend more like the bamboo and enable it to weather the storm. Being indigenous, Ficus does not yield like the cultivated exotic species of rubber-bearing trees to the attacks of fungoid and other parasites, unless when it has been enfeebled by some extraneous influence. If, for example, a tree has been drained of its latex by excessive tapping, borers find lodgment in the bark.

By careful pruning a young plant can be made to develop a single trunk like a Hevea tree, and this is more easily accomplished when the subject has been grown from a layer in place of a seed In the wild state the minute seeds from the disintegrated fig, which is its fruit, sprout on the bark of adjacent light-foliaged trees, or on dead and dying trees, where wind storms have broken the forest roof and let in the sunlight. For a time the young plant lives as a slender and tender epiphyte, but, on the aerial roots reaching the rich dry soil which they love, this tenderling rapidly develops into a giant of the forest.

DOES NOT DO WELL IN THE EAST.

When systematic rubber cultivation began in the East, only a few years ago, the robust and healthy growth of Ficus on rich soil misled a good many practical people, and a preference, which it did not deserve, was at first accorded to *Ficus elastica* over *Hevea*

*brasiliensis*. Prolonged observation has, however, taught the planter wisdom, and it is now the almost universal experience in the Malay Peninsula, the centre of the world's cultivated rubber industry, to find that the Ficus had been tapped to death and pulled out to make room for Hevea. Scientific opinion in the East is in accord with the views of the most enlightened of the practical planters.

One of those experts who have emphatically warned the public against the inherent defects of *Ficus elastica* as a reliable source of rubber in a cultivated state is M. Georges Vernet, Chemist to the Pasteur Institute at Nha-Trang, Anam. He, like the present writer, undertook an extended round of travel in the East to personally examine the Ficus tree growing under a great variety of conditions. In his " Etude generale sur le Ficus elastica" (Roxb. Saigon, 1909), and reprinted, with illustrations, in the Journal: Le Caoutchouc et la Gutta Percha (Paris), M. Vernet has supplemented his earlier personal observations and experiments, at Hanoi and elsewhere, with an elaborate analysis of all available records of the productivity of the plant in question, and in a letter he goes so far as to suggest that probably the original fancy of the Dutch for the Ficus was the cause of Java being now ten years behind the Malay States in the matter of rubber planting and growing.

### EFFECTS OF TAPPING.

M. Vernet finds that owing to the structure and distribution of the latex-tubes in the inner recently-formed bark a thorough tapping of a Ficus tree so drains its reservoirs that it is absolutely necessary if a remunerative yield is expected, to allow a considerable time to elapse to permit of the formation of new tubes before tapping the same part. If, for example, from a well-developed Ficus tree two pounds of rubber be extracted in the first year of tapping, the yield in the second year is only one pound, or half the former amount, and in the third year half a pound. This declining yield is followed by four or five practically barren years in which little or nothing can be extracted. The only way a steady, though poor annual yield may be obtained from this species is when the tree assumes dimensions large enough, to divide its numerous limbs and branches

into five or six sections and tap, in rotation, a section each year. M. Vernet concludes his study in the following terms :—

"Whether my only hypothesis be confirmed or disproved—*i.e.*, whether it is true or not that the subsequent annual yield of the Ficus can be calculated from the average first yield—I advise the Tonkin colonists, and indeed all rubber-growers throughout the world, to make no new plantations of this species until a strain of Ficus has been produced by selection capable of giving a higher and a steady yield of latex. At present we have to deal with a tree that makes enormous demands upon the soil and has a very low power of production; its cultivation could be remunerative only if the cost of a plantation were practically *nil*."

The soundness of the last statement is confirmed by the fact that vast numbers of wild *Ficus elastica* trees exist all over the areas to which it is indigenous, and only in a comparatively few centres is rubber extracted under conditions in which there is no outlay for cultivation. That a more productive variety of Ficus may be found is possible, but it is significant that, although one Hevea tree differs vastly from another in productiveness, no superior variety has yet been found which can be depended upon to perpetuate its good qualities.

### MR. RIDLEY'S OPINION.

Director H. N. Ridley, of the Botanic Gardens, Singapore, and Director Paul Morange, of the Botanic Gardens, Saigon, both strongly support M. Vernet's views and condemn Ficus as worthless, and they no longer produce a supply of young plants for the public. Even at Buitenzorg, where at one time Dr. Treub advocated the claims of the indigenous species on the ground of its immunity from the common disease of important trees, the present rubber expert, Mr. Tromp Hass, realises that the planter of the present must have not merely a robust tree, but one that will give large and immediate returns. Perhaps the most favourable instance of what might be termed a successful Ficus or (to use the Javanese name) Karet plantation may be found at Pamanœtan and Spassem-landen, Sœbang, about a day's journey from Batavia

There, in 1865, 200 acres were planted, but tapping was not begun till 1885. The gross return in 15 years amounted to £25,000 from rubber sold. This yield of about £8 per acre to meet outlays and provide profit, after waiting for 20 years for the first return, does not form a paying proposition to attract capital.

### COMPARATIVE YIELDS.

An estimate of the comparative yields of Hevea and Ficus advanced at the meeting of the Caoutchouc Congress at Djember, Java, October 1907, credited Hevea with a yield of 70 kg. of rubber per hectare in its sixth year, and Karet with 20 kg. in its seventh year. The rubber derived from the Ficus tree is pink in colour, like its wood, and, although strong, is inferior in quality, partly owing to an excess of resin. The expenses of tapping are high. With Para rubber costing 10 cents per pound to collect in Malaysia, Rambong, the product of F. elastica, costs 25 cents per pound. Although at Buitenzorg Ficus trees, pruned to produce but one trunk, are tapped in the herring-bone system with a draw gouge and sharp flat pricker, without injuring the cambium, the usual method with untrained trees is to make deep gashes in the bark of both stems and leading branches, and to allow the milk-white latex, which flows freely, to drip upon mats or banana leaves spread on the ground below. There, and on the living bark where some remains, it dries into the consistency of rubber. Ficus latex is more difficult to manipulate than Para latex, as it tends to remain in the fluid state, and will not coagulate by acid. The addition of a moderate amount of Hevea latex, or of that from mature Ficus trees, has the effect of breaking down the intractable condition.

The moral to be drawn by the would-be investor from the lesson of this modern *ignis fatuus, alias Ficus elastica* is that—following the precepts of the scientists who have made it their study, and of the planters who have made it their practice to discard it as worthless—he should in turn discard the misleading reports and prospectuses of unscrupulous company promoters who still essay to laud the elusive promises of *Ficus elastica*.—[*Straits Budget.*]

## DESTROYING A WOODEN BRIDGE BY ELECTRICITY.

An interesting use of electricity was recently demonstrated in England, where a wooden bridge was cut down by means of electrically heated wires. The bridge had been condemned, and was to be replaced by a steel structure supported on the old masonry piers and abutments. Three weeks were allowed in which to dismantle the woodwork, but it proved impossible to accomplish the work in so short a time without the use of dynamite or fire, which undoubtedly would have injured the masonry. Finally an electrician proposed to destroy the bridge by the use of electricity. Each span of the bridge contained twenty-seven planks, and it was proposed to cut them so that they would drop into the water simultaneously, clear of the piers. The structure was wired and sufficient current was employed to bring the wires to a cherry-red. An hour and forty minutes after the current was applied, the first span was cut and fell into the water. The operation was begun at 5 o'clock in the morning, and at 2 o'clock at night the structure had been demolished without injuring the masonry.—[*Scientific American.*]

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## CORRESPONDENCE

VOLUME XXXVII NUMBER 11.

# INDIAN FORESTER

*NOVEMBER, 1911.*

## FOREST RESEARCH IN INDIA.

### I.

In is now five years since the Forest Research Institute at Dehra Dun was brought into existence, and it may be of interest to our readers to learn what has been done during this period, what remains to be done, in what respects the original proposals have succeeded or failed, and what in our opinion are the steps desirable for furthering the cause of Forest Research in India.

It may be remembered that the constitution of the Forest Research Institute was announced in Government of India's Circular No. 11-166-2F., dated 5th June 1906, six research officers being appointed, namely, (i) a Sylviculturist, (ii) a Superintendent of Forest Working-plans, (iii) a Forest Zoologist, (iv) a Forest Botanist, (v) a Forest Chemist, and (vi) a Forest Economist. That the establishment of such a Research Institute was acceptable to Government may be gathered from the following words written by His Excellency the Viceroy in according his sanction to the proposal :—

"The point that interests me most is that these proposals are in reality only a further adaptation of the principles which, with

increasing knowledge, a wider conception of Indian possibilities and a relatively full treasury, we are beginning to apply to every branch of Indian industry and economics. We are in fact now invited to do for forestry what we have already done for agriculture. I find in the proposals a perhaps not fully conscious illustration of another principle to which equal importance has to be attached, namely, that of rendering India self-contained and self-providing. Hitherto we have been running all over Europe for our scientific equipment and often for our scientific manufactures. Any measure that will enable India to do for itself what it now has to get others to do for it, or perhaps not do at all, seems to me to deserve our hearty support. I therefore gladly approve the proposals."

These words are memorable as indicating on the part of our rulers a broad-minded and far-seeing view of scientific and economic forestry, which has manifested itself none too soon. The dawn of scientific forestry in India may be said to date from 1856 when Brandis was appointed to organise and administer the teak forests of Pegu. Thus for 50 years we have beheld a scientific department, at all times undermanned, devoting its energies to the work of organisation and administration, with little attempt to co-ordinate or elaborate the scientific knowledge so necessary to successful economic working. It may indeed be said that practically all the important scientific work done by Forest Officers prior to 1906 was the outcome of individual efforts on the part of enthusiasts in the particular branch of work concerned. To take systematic Botany as an example, we have the names of such workers as Brandis, Gamble, Beddome, Talbot, Bourdillon, Lace, Haines, Kanjilal, and others. In order to write his "Forest Flora" Brandis was placed on special duty, and his "Indian Trees" was produced long after his retirement from active service. Gamble's work connected with Indian timbers started with his executive charge of the collection of woods made for the Paris Exhibition of 1878, at the time when he held the post of Assistant to the Inspector-General of Forests. Years later his residence at Dehra Dun, and access to the excellent wood collection, the library and herbarium,

helped him in the preparation of the second edition of his "Manual of Indian Timbers," which has proved of priceless value to the Forest Officer. Talbot's *magnum opus* is only now appearing, after his departure from the country and the distractions of administrative routine work. Kanjilal's "Forest Flora of the School Circle" was the outcome of long residence at Dehra Dun with its attendant facilities for the production of a work of the kind. We may here refer to Haines' excellent Forest Flora of Chota Nagpur, for although it was published after 1906, much of the initial field work was done before that date: in connection with this Flora a great deal of important work was done during a period of special duty and also during the author's brief tenure of the post of Forest Botanist at the Research Institute, during which period part of the actual writing was done, the remainder being completed on furlough in England.

We have dealt with this aspect of the question at some length in order to establish two points with regard to scientific workers in the Forest Department prior to the establishment of the Research Institute, first, that their efforts were individual and not the result of any organised attempt to co-ordinate their particular branch of work with the general work of a well-equipped Institution, and, second, that in the majority of cases their work has been aided by exceptional circumstances, such as the tenure of special posts, or the leisure afforded during leave or retirement. In bringing forward these conclusions we do not suggest for a moment that Forest Officers as a class have been backward in devoting themselves individually to the solution of scientific or economic problems. What we do maintain, however, is that a vast amount of useful original work has become irrevocably lost, owing to the absence of an organised system of carrying out investigations and [illegible]ing results; in other words, the available results of former [illegible]ons carried out by Forest Officers do very small justice [illegible]ount of time and labour spent on them.

[illegible]shall return later to the question of scientific investigations [illegible]officers, and will now consider the work done up to date [illegible]orest Research Institute since its constitution in 1906.

It may be stated by way of explanation for any shortcomings which may have manifested themselves, that the Institute has suffered greatly ever since its commencement, and particularly in its earlier years, from lack of funds. For this reason research in Sylviculture was never even attempted till 1909-10, a whole-time incumbent of the post not being available because of the attempt, in the interests of economy, to double up research work with an undue amount of educational work instead of providing an adequate staff for each. The question as to the amount of educational work which a Research Officer in any branch of science may reasonably be called upon to do is not an easy one to decide. On the one hand it is desirable that new ideas and new discoveries, elicited during the course of research, should be disseminated among students, while on the other hand if Research Officers are to have too much of their time taken up with educational duties, little or no progress in research work is possible. The method now in force at Dehra Dun deals as satisfactorily with the situation as circumstances will permit. Under this system new ideas are disseminated by Research Officers (1) by the delivery of a limited number of lectures, (2) by the publication of College text-books which will be periodically revised, (3) by intercourse with the College Instructors, who are responsible for all the practical training, and much of the theoretical training, of the students.

Turning now to the purely research side, as part from the educational side, of the Institute, we may enquire what the duties of a Research Officer should be and how far they have been realised up to date. The following we may take to be the main duties of the Research Officer, and the extent to which these duties have been fulfilled so far :—

(1) He should keep himself up to date with the progress of work and thought in his particular branch, not on India but in different parts of the world ; th access to all the latest literature pertaini special subject, and it implies also preferab knowledge of French and German. The Institute is kept well supplied with the latest l

in the shape of books, periodicals and other publications.

(2) The Research Officer should collect and collate all such information so that it may be readily available for reference: this is provided for in some of the Research branches by recording information systematically in ledger files.

(3) Where collections are required for reference the Research Officer should form such collections and add to them constantly. At Dehra Dun is to be found the most extensive collection of Indian woods in the world, of which the bulk was brought together by Gamble, but which has been added considerably since his time; there is a good herbarium, which is being increased rapidly, a good museum of Forest Economic products, a moderate Zoological collection, and last but not the least important, a Sylvicultural collection which, strange to say, hardly existed until quite recently, has been commenced and is being pushed on.

(4) The Research Officer should carry out original research in his particular branch, under a definite programme and with the object of bringing his investigations to a definite conclusion. This may consist of mere local enquiries, or it may involve experimental work of a more or less detailed description, extending, it may be, over only a day or two, as in the chemical analysis of some sample, or over several years, as is the case with many sylvicultural investigations. At the Research Institute work is done either in the different laboratories, or in experimental stations at Dehra or in the forests. There are at present three experimental gardens, namely, a sylvicultural nursery of 1½ acres and garden of 10 acres, and a botanical garden. Experimental work in these is supplemented wherever necessary by observations and experiments in the forest. We may here note that the work of collecting

statistical information by the periodic measurement of demarcated sample plots is in the hands of the Sylviculturist.

(5) The Research Officer should give advice and assistance in his own branch of work to Forest Officers and other *bonâ fide* enquirers who may seek it ; this has already been done in numerous cases, and as the Research Institute develops its usefulness in this respect should increase.

(6) The Research Officer should publish from time to time the results of his investigations. This has been provided for by the issue of (i) Forest Memoirs, (ii) Forest Records, (iii) Forest Pamphlets, (iv) Forest Leaflets ; Nos. (iii) and (iv) have recently been dispensed with in favour of (v) Forest Bulletins, so that three types of research publications are now issued. From 1906 and up to the 30th June 1911 the following forest publications have been issued or were in the press on the latter date :—

| Class of publication. | By Research Officers. | By other Forest Officers. | Total. |
|---|---|---|---|
| *Research Publications.* | | | |
| (i) Memoirs (separate monographs) ... | 11 | ... | 11 |
| (ii) Records (separate articles) ... ... | 12 | 4 | 16 |
| (iii) Pamphlets ... ... ... | 13 | 3 | 16 |
| (iv) Leaflets ... ... ... | 5 | ... | 5 |
| (v) Bulletins (including those of old series from 1906). | 12 | 3 | 15 |
| Total research publications ... | 53 | 10 | 63 |
| *Other publications.* | | | |
| (vi) Text-books ... ... ... | 6 | 1* | 7 |
| (vii) Various ... ... ... | 4 | 3 | 7 |
| Grand Total ... | 63 | 14 | 77 |

* By former member of Forest School staff.

We have attempted in the previous paragraph to outline the main duties of the officers of the Forest Research Institute and the results attained up to date, which it must be admitted are not unsatisfactory considering that (1) pending the erection of new and fully equipped Research Institute buildings the offices and laboratories have been located in scattered temporary quarters, where the want of accommodation and proper equipment has been seriously felt, (2) one or two of the Research Officers were severely handicapped for the first few years by an undue amount of educational work, (3) the preliminary work of organisation was heavy and difficult, and in some cases left little time for research work—matters were not simplified by the introduction of cumbrous rules of procedure, many of which might have been advantageously dispensed with, (4) the assistant staff, so necessary in the routine details of experimental work, was either inadequate or totally wanting—this difficulty unfortunately still holds, and is a serious obstacle to progress.

The question whether or not the Forest Research Institute has justified its existence is one which naturally presents itself to anyone interested in Indian Forestry. If the enquirer is on the lookout for figures expressing a direct financial profit on the outlay which the establishment and upkeep of such an Institute entails, then he is doomed to disappointment, for in the first place the Institute has not been in existence nearly long enough to show the results which it will without doubt eventually show, and in the second place the results of forest research cannot always be expressed in a direct money profit or even in the direct saving which might be expected to follow on improved methods of working. In estimating the utility of the Forest Research Institute we must for some time to come look rather to its effect on the development of the forest resources of the country, to economic methods of exploitation, improvements in sylvicultural systems, methods of regeneration, and so on. Even in the short period during which the Research Institute has been in existence, we can cite several instances of progress directly traceable to its efforts. An impetus has been given to the introduction of more rational

system of working our *sál* and teak forests, a large experimental area having been established to test the applicability of the method of successive regeneration fellings in the former ; improvements in the distillation of turpentine have been introduced which should result in direct pecuniary benefit ; investigations into the question of woods suitable for matches have to our certain knowledge resulted in the establishment of at least one large match factory which the promoters had not dreamed of before the results of the investigations were published, while numerous enquiries from other sources regarding the possibilities of the match industry may lead to further developments in what is likely to prove an important Indian industry; the subject of paper-pulp from bamboos and other raw materials is being investigated at the Research Institute by an expert, and there can be little doubt that the results will open out an important field for commercial enterprise, while at the same time providing a market for large quantities of produce which at present goes to waste. Further instances need not be quoted, but we confidently anticipate still greater developments in the future if the Research Institute is given the encouragement, financial and otherwise, which is essential to its success.

We have already seen that the original Research Institute staff consisted of (i) a Sylviculturist, (ii) a Superintendent of Forest Working-plans, (iii) a Forest Zoologist, (iv) a Forest Botanist, (v) a Forest Chemist, and (vi) a Forest Economist. This distribution of posts was recognised to be tentative, and certain alterations were, after experience, considered to be necessary, it being found expedient to entrust research work in Working-plans to the Sylviculturist. The list of posts therefore now stands as follows: (i) a Sylviculturist, (ii) a Forest Zoologist, (iii) a Forest Botanist, (iv) a Forest Chemist and (v) a Forest Economist. Such is the Research Institute staff as we have it now, and this we are bound to look on as the irreducible minimum, the bed rock or foundation on which we hope eventually to see a more extensive structure built up.

We have already alluded to the question of unduly hampering Research Officers with educational duties. The original Sylviculturist's post was doubled up with that of the Principal of the Forest College, who had no time to devote to research work; the effect was disastrous, for it resulted in an entire absence of all work in the most important branch of forest research for nearly four years. The doubling up of the posts of Sylviculturist and Superintendent of Forest Working-plans is somewhat in the nature of an experiment, but we believe that the results will be beneficial provided an Imperial Service Officer is appointed before long as assistant to the Sylviculturist. So far the most important event in the career of the Forest Research Institute since its constitution has been the first meeting of the Board of Forestry, held at Dehra Dun in March and April 1910, and consisting of a Chief Conservator and a representative gathering of Conservators, presided over by the Inspector-General of Forests, and attended by the Hon'ble Member of Council and the Secretary to the Government of India in the Revenue and Agricultural Department. This meeting was the first real attempt to interest the Department as a whole in Forest Research. The Hon'ble Mr. Miller's address on this occasion, which was reported in our May number for 1910, was of great interest to the Department as a whole, and we shall have occasion to refer to it below. Among the important resolutions of the Board perhaps the one affecting the inner working of the Research Institute most intimately was the acceptance of a proposal to form a separate Imperial cadre for the Research Institute and College on lines similar to those of a Province, and to constitute the list of Research post as follows :—

I.—POSTS PORDINARILY HELD BY OFFICERS OF THE IMPERIAL FOREST SERVICE.

(1) Sylviculturist.
(2) Assistant Sylviculturist.
(3) Forest Economist.

II.—POSTS ORDINARILY HELD BY EXPERTS TRAINED IN THE SPECIAL SUBJECTS.

(4) Forest Botanist and Mycologist.

(5) Forest Chemist.

(6) Forest Zoologist.

(7) Forest Engineer.

III.—POSTS ORDINARILY HELD BY OFFICERS OF THE PROVINCIAL FOREST SERVICE.

(8) Assistant Zoologist.

The Board's decision in the matter of staff embodied two important views, first that the present staff is inadequate, and second that the tenure of Research posts by Forest Officers of the Imperial Service should be confined to the two Forestry subjects pure and simple, namely, Sylviculture and Forest Utilisation, the other posts being ordinarily held by specially trained experts. In this connection it may be noted that the Chemist's post is already held by a trained chemist from outside the Department, and the Zoologist's post has recently been filled by a trained Zoologist. The necessity for the increase in the Research Institute staff, as approved by the Board of Forestry, is admitted on all hands, and we have already drawn attention, in our editorial of May 1909, to the question of a Forest Engineer. The constitution of the extra posts in the near future is a matter of urgency if research work is to show anything like normal development; the only obstacle to the immediate increase of staff required is lack of funds, and unfortunately the present unsatisfactory financial conditions do not tend to raise our immediate hopes. It is confidently anticipated, however, that the requirements of the Research Institute will not be neglected with the advent of more prosperous times.

Leaving for the present the question of personnel, and turning to that of buildings and equipment, we may say that matters are at present in a state of flux. The various research offices, laboratories and museums are scattered about in different buildings, and work is much handicapped in consequence. A large Research Institute building is to be erected at a cost of about Rs. 1,60,000 including accessory buildings. Land for the accommodation of these has been acquired, and it is expected that their construction will be commenced at an early date. The main edifice will be one of high architectural merit combined with utility, and will occupy

one of the finest sites in Dehra Dun. The completion of the new buildings will be followed by a re-arrangement of existing museums and laboratories, which will be extended and equipped in a manner hitherto impossible for lack of accommodation. We have already alluded to the experimental gardens of the Institute, which it may be possible to extend when space for the buildings and other requirements has been allotted.

*(To be continued.)*

## THE UNIFORM SYSTEM FOR SAL FOREST.

There seems to be a good deal of divergence of opinion *among Forest Officers as to what lines should be followed in* introducing the uniform system of working for sal forest of the selection system type.

There is little doubt that as working-plans for sal forests come under revision, proposals for conversion to a regular system of *working will be their chief feature. In two divisions in the United* Provinces for which preliminary working-plan reports have recently been submitted, conversion to the uniform system has been recommended for large areas of sal forests. In both these reports, however, only general outlines of the procedure to be *followed have been given and much is left for the working-plans* officers to thrash out for themselves.

The present article is being written to invite discussion, criticism and exchange of views on the subject in the pages of the *Forester.*

*The sal forests with which we have to deal have for the most* part got all girth classes represented throughout their area, the -oportion between the various classes varying in differen ''ities.

e first thing to decide is how much of the sal bearing area converted to the uniform system.

shall presumably have to exclude—

i) inaccessible hill forest;

(ii) forest burdened by grazing rights.

The latter could probably not be closed for purposes of regeneration, and moreover, if successfully converted to even-aged forest, would fail to provide pasturage for cattle of right-holders.

With these two exceptions there seems no objection to including the remaining more or less pure sal forests, whether good or indifferent, into a uniform working circle.

The next point to consider is whether one or more felling series are desirable. Multiplication of felling series is evidently to be avoided in order that full advantage may be taken of the ability to concentrate working which is rendered possible by the uniform system. It should therefore be our aim to have only one felling series in our working circle or anyway as few as possible. In the case of the two forest divisions referred to above, it has been laid down (i) that working shall be by coupes of comparatively equal area, and (ii) that in making the principal conversion fellings only trees of the I and II classes shall be felled, leaving the trees of the III class and under to form part of the future comparatively even-aged crops.

It would seem that this second prescription settles the period for converting the whole area into a series of even-aged crops for the following reason.

After the principal fellings we shall have trees of the III class and under left (*i.e.*) the mean girth of our stock will be $\frac{0+4\frac{1}{2}\text{ ft.}}{2}$ $= 2\frac{1}{4}$ ft. Theoretically therefore we should divide our total area into as many annual coupes of equal area as it will take a tree of $2\frac{1}{4}$ feet girth to attain to maturity, say 6 feet in girth.

For purposes of illustration let us assume the age of a $2\frac{1}{4}$ feet girth tree to be 33 years and the rotation at which sal reaches maturity under the uniform system of treatment to be 132 years then the time taken by our average tree to become mature will [illegible] 99 years. We should therefore work 1/99 of our total area [illegible] ally by successive fellings in 99 annual coupes.

At the end of 99 years we should have a series [illegible] or less even-aged coupes with trees varying from mat[illegible] the average in coupe 1, to $2\frac{1}{4}$ feet girth on the ave[illegible] coupe 99.

A hundred years hence is rather a far cry. Still it is evident that the next felling cycle should correspond to the number of years in the rotation at which sal becomes mature say 132 years, and the whole forest will then have to be divided into 132 annual coupes. In this second felling cycle the age of the stock at the time of the principal fellings will vary from 132 years in coupe No. 1 to 165 years in coupe No. 132; each successive crop felled being ¼ year older than that of the preceding coupe, when it was felled.

It will not be until the third felling cycle that the correct succession of even-aged crops can be arrived at.

The diagrams will perhaps make things clearer.

Returning to the present day, we may for convenience divide our felling series into three periodic blocks of comparatively equal area. In the first periodic block which is to come first under conversion, areas will contain as far as possible an excess of I class trees and sufficient advance growth to render seed fellings unnecessary; periodic block II will contain forest in which II and III class trees are well represented, and to periodic block III will be allotted poorly stocked areas and those in which the younger age classes predominate.

It will be our aim to treat the forests in periodic blocks II and III so that they shall contain sufficient advance growth when they come under conversion that seed fellings may be dispensed with in their case also.

The scheme is outlined as follows :—

PRESCRIPTIONS.

| Period. | Periodic Block I. | Periodic Block II. | Periodic Block III. |
|---|---|---|---|
| I 1–33 years. | *(Under Conversion.)* Primary Felling. One coupe annually, starting with No. 1 and progressing serially. In this felling all I and II class trees not required as shelter trees or seed-bearers will be removed. | Selection Fellings. Improvement Fellings. Cultural Operations. } For the first half of the period. | Selection Fellings. Improvement Fellings Cultural Operations. |
| | Final Fellings. As indicated by the condition of advance growth. | Improvement Fellings. Cultural Operations. } For the latter half of the period. | ...... |
| | Cultural Operations. Such as wounding the soil, and planting and sowing up blanks, cutting back, climber cutting and girdling. | ...... | ...... |

| | | | |
|---|---|---|---|
| | Improvement Fellings. Over $\frac{2}{3}$ of the block:— 2 coupes to be worked annually starting with Nos. 12 and 13 and progressing serially. In these fellings overmature trees showing signs of deterioration and unsound material generally will be removed. | ...... | ...... |
| **II** 34–66 years. | Final Fellings. Completed.<br>Cultural Operations. | (*Under Conversion.*)<br>Primary Felling.<br>Final Fellings.<br>Cultural Operations.<br>Improvement Fellings. | Selection Fellings. / Improvement Fellings. / Cultural Operations. } For the first half of the period.<br>Improvement Fellings. / Cultural Operations. } For the latter half of the period. |
| **III** 67–99 years. | Thinnings. | Final Fellings. (Completed.)<br>Cultural Operations. | (*Under Conversion.*)<br>Primary Fellings.<br>Final Fellings.<br>Cultural Operations.<br>Improvement Fellings. |

E. R. STEVENS.

## MEMOIRS OF FORESTRY IN A NATIVE STATE.

The idea is commonly prevalent, and with some reason, that till comparatively recently forests were considered as of no importance in Native States; indeed I myself remember the opinion of some high Revenue officials in the premier Native State not so very long ago that trees simply encumbered the ground and must be got rid of at any cost. It may therefore interest some of your readers to know that in the Indore State, its far-seeing ruler Maharaja Tukojirao Holkar and his Ministers framed excellent and drastic rules and circulars as long ago as the early seventies for the protection of the State forests. Some of these circulars have only recently come to light and pay particular attention to irregular fellings, location of fellings, fire-protection, extraction of produce, grazing, the provision of the agricultural and domestic requirements of the people, etc. Unfortunately the establishment was inefficient and corrupt, underpaid and very weak, the Conservator's pay being Rs. 100 per memsem, so unfortunately all these rules and regulations were more honoured in their breach than their observance. Nevertheless teak was always rigidly protected even if at times illicitly cut, till the commencement of the reorganisation of the Department, when many of the best teak forests were most unfortunately much damaged and destroyed between the years 1903—1905 for extension of cultivation or on that pretence.

I am told by a gentleman, one of the oldest residents in the State, who had access to a mass of interesting papers of the time referred to, that Dewan Bahadur R. Raghunathrao, the Minister of the State, a recognised Revenue authority at one time and even now, reported to the Maharaja that unless forests were better supervised fuel would become dearer than food, which shows the inefficiency of the staff in complying with the drastic orders and circulars of the Durbar. I may quote here one of them dated as far back as 1868, well *calculated* to inspire dread of the consequences of starting forest fires :—" Whoever sets fire to a hill or grass area will be deemed a grave offender and shall be punished with rigorous imprisonment for fifteen years and his property will be confiscated to the State and his family banished."

Some of the circulars were difficult to act on in a practical manner, for instance ryots were permitted to fell "Mhowa" trees in their holdings if for each tree felled they planted two young ones; people living in remote forest tracts must bring home their cattle before sunset; any one failing to do so will be fined one anna daily, and in such places strong stockades at the backs of the houses with locked doors must be constructed for the cattle, timber being provided free, with a view apparently to aid in protecting cattle from wild animals or dacoits. I must not take up too much of your space in quoting other circulars. Had I known of the existence of some it would have been unnecessary to frame others of very similar purport which the Durbar passed at my request after I took charge of the State Forest Department in 1905.

The Maharaja Tukojirao II was a most remarkable man of untiring energy, capable, clever, shrewd, an indefatigable worker I sometimes meet old *patels* in remote parts of the districts who talk of his visiting their villages with perhaps only one or two attendants and how he talked to them freely, taking the greatest interest in all their affairs, and advanced money for wells, new cultivation and all their needs. No doubt he was a shrewd financier, and the State revenues ultimately benefited greatly by his liberal advances.

The Maharaja was always accessible to all, both when on tour and when transacting work, as he always did in open Durbar. He is said to have known not only every village in his State, but almost every cultivator and field in them. He toured at all times of the year. Much of this information I have gathered from a most interesting monograph lately written by Rai Bahadur Krishnarao Muley, Member of the Council of Regency, who describes how one wet day the Maharaja started suddenly in the afternoon to see to some business and riding an elephant travelled some 50 miles with only one attendant (Mr. Muley's father).

Mr. Muley remarks that His Highness could endure any extremes of heat or cold; at every place visited the minutest inspection of tahsil and village accounts, etc., was done. During his long reign of 42 years the State revenue rose from 17 lakhs to

74 lakhs of rupees. I have not been able to ascertain the actual forest revenue of the period, but it was certainly very small. His Highness the Maharaja Sewajeerao Holkar who succeeded him in 1886 and whose reign ended in 1902 does not seem to have taken much personal interest in forestry, but he was strict in protecting teak, and the important Barwaha forests were preserved largely through his influence with his father and some useful circulars were issued in his time, also chiefly under the signature of the present Minister Rai Bahadur Nanak Chand, C.I.E.

INDORE, C. I. W. F. BISCOE.
*19th August* 1911.

## SYLVICULTURE IN BURMA.

(PART III.)

It is generally held to be impracticable to carry out even the small amount of improvement fellings at present prescribed. Nevertheless I shall attempt to show that it would be possible to carry out a scheme of improvement fellings on a rotation of ten years, which would involve at least three times the amount of work.

It seems hardly to our credit that we should never fail to find time to carry out girdlings and other works necessary for the realisation of revenue, yet persistently neglect works for the purpose of improving, or even of maintaining the value of our forests. Exploitation impoverishes a forest and the principal reason we are being employed is to counteract these effects, and therefore, however difficult it may be, it seems to me essential that we should carry out an adequate scheme of improvements.

The actual cost of carrying out improvement fellings has averaged in the past about eight annas per acre. However, in order not to underestimate, the cost may be put down at one rupee in ten years, or Rs. 64 per square mile per annum. The total area of reserved forests considered of sufficient value to be brought

under regular working-plans amounted, according to the last returns, to 7,279 square miles, and therefore the total cost of improvement fellings on a ten years' rotation for the whole of Burma would only amount to Rs. 4,65,858 or roughly Rs. 5,00,000. Seeing that we are realising an annual revenue of some Rs. 90,00,000 I do not anticipate that there would be any difficulty in obtaining the necessary funds.

The difficulty is generally attributed to the inadequacy of the staff. The cost of establishment under BI, *i.e.*, pay only, exclusive of buildings, travelling allowance, contingencies, etc., amounts to some Rs. 14,00,000. Part of the time of the staff is taken up with works in connection with the collection of revenue, but so-called departmental extraction has been almost entirely given up, and the time spent on girdling teak in the forest, and measuring it at the depôt, is not great. However, without making an elaborate calculation of the time spent on different works, I think it may reasonably be assumed that half the time of the staff is available for supervising sylvicultural works. On this basis the cost of supervision would amount to Rs. 7,00,000. As pointed out the total cost of a scheme of improvement fellings carried out on a ten years' rotation would only amount to Rs. 5,00,000, and therefore if the staff is inadequate there would appear to be something radically wrong with the organisation.

There is also food for reflection in the fact that in the Toungoo Division which is, I believe, the most strenuous division in Burma, the area over which improvement fellings were carried out last year was greater than in the whole of any other forest circle. The Prome Division has the reputation of being the second busiest division, but in this division more improvement fellings were carried out than in any other division except Toungoo.

One of the greatest obstacles is, I consider, fire-protection. It is necessary to go round one's division early in January to ascertain that the fire-lines have been properly cleared. Almost immediately afterwards leaves begin to fall heavily, and this is perhaps the most critical time, as the lines have to be burnt back and be kept continually swept. During the hot weather the leaves become as

dry as tinder and it is necessary to go round constantly to keep the patrols alert and watchful. In addition, there are hosts of minor matters to be attended to, and therefore from the beginning of January to the end of the open season our time is fully occupied. Earlier in the season we have a large programme of thinnings, girdlings, etc., to carry out, and therefore it certainly seems difficult to carry out any other major operations. It seems to me that we must concentrate our energies either on fire-protection or on improvement fellings, but that we cannot do both, and for my part I have not hesitated to say that fire-protection must go. It seems to me that the case for fire-protection is based entirely on intuition and imagination. We are not, however, sentimental old women, but shrewd practical members of a semi-business department, and should be influenced entirely by the evidence. An Imperial Forest Sylviculturalist has made a special journey to Burma to enquire into the subject, but the only evidence he collected proved that fire-protection was ruining these forests. A Chief Conservator of Forests has gone personally into the matter, with the same result. Divisional Officers have expressed their opinion on every opportunity. Yet we still devote more time and money to fire-protection than to all other works. I am told that I regard fire-protection as a bull a red rag, but I have gone carefully into the probable financial results of fire-protection and cannot find a vestige of profit in it. On the other hand I calculate that improvement fellings would yield extraordinarily fine results. Seeing also that I am of the opinion that fire-protection is the main obstacle which prevents an adequate scheme of improvement fellings being carried out, I find it more difficult to understand the general apathy on the subject, than to justify my antipathy.

There is however another very serious obstacle, namely, that in the present state of opinion it is not considered right or desirable to entrust important works, such as girdling or improvement fellings, to subordinates. We have, I am afraid, little confidence in our subordinates and we are perhaps influenced by the sentiment that if one wants work well done one should do it oneself. These works call for great physical energy and I think there is a natural tendency to

over-estimate the worth of physical energy, and a disinclination to incur, by shirking these works, the unpleasant feeling that one is slack. Teak is generally found in broken and hilly country, and is sparsely scattered, and when after scrambling from dawn till dusk, up steep hillsides, across deep ravines and down precipitous khuds, we return from girdling, weary to camp, we have the pleasant feeling that we have thoroughly earned our pay. It is also, I think, a tradition to display great physical activity and energy. Our predecessors had to ensure that extraction should be based on sylvicultural principles, and to maintain the outturn in order not to dislocate the market. In addition, they had to examine the forests in order to select blocks of forests for reservation. This necessitated their spending month after month in little known forests, not only personally selecting most of the trees for girdling, but at the same time making surveys on which our legacy of reserves is based. This involved, and the work could not possibly have been done without, great physical energy, but conditions have changed and I think we shall have to adjust our ideas accordingly.

We have to remember that the areas with which we have to deal are large and the staff of gazetted officers small. But what we lack in quantity, judging by the rates of pay, we make up in quality. To us is naturally assigned the task of supplying the brains while our subordinates act as hands to carry out work under our direction. So long, however, as we insist on doing the principal works such as girdling and improvement fellings ourselves, it will be a practicable impossibility to carry out any but an extremely small programme of works. According to my views it is necessary to carry out improvement fellings on a rotation of ten years over all reserves for which working-plans have been prepared. Seeing that we realise a revenue of Rs. 90,00,000 and that the work is only estimated to cost Rs. 5,00,000 it is evident that this is a very modest programme to begin with. Yet if the work could only be entrusted to gazetted officers it could not be done. An average division contains about 600 square miles of reserve forests and is managed by a staff of two gazetted officers, five rangers, and fifty subordinates of lower grades. In such a division

60 square miles or 38 compartments of about 1,000 acres would have to be operated over annually, and assuming that a compartment could be completed in two months, at least seven gazetted officers would be required for this work alone, apart from girdling and other work, and they would have to work continuously for the whole twelve months.

A gazetted officer is however an expensive luxury. Not only has his pay, which is a considerable item, to be considered, but also his travelling allowance, cost of quarters, office, elephants, clerks, peons and Bally paper. A considerable increase has recently been sanctioned and it was, I believe, expected that this would result in an increase of revenue. These hopes will, I think, not be fulfilled. There is no reason to believe that we have allowed many opportunities of securing legitimate revenue to slip by, and although there may be a steady increase due to the opening out of the country and to the increasing value of forest produce, yet this could, I think, have been coped with by the former establishment. However this may be, it is quite certain that any further increase would be entirely at the expense of the net revenue. At the present time the finances of the province are causing misgivings, and now that the Local Government has a direct interest in the net surplus forest revenue, there is not the slightest chance that any proposal for further increase would be favourably received. It seems to me, therefore, that we have got to make the present establishment suffice, and in my opinion the only solution is to entrust more work to subordinates.

The importance of the work is not a sufficient reason for not entrusting it to subordinates. The only sound criterion is whether or not subordinates have sufficient ability and honesty to carry out work properly. In some parts of India, I believe, even the forest guards are B. A.'s, but I doubt whether they have the same natural instinct for forestry as many of our Burma subordinates. Most Burmans can run up a shelter of bamboo, and find roots and delicacies for their food, and generally can make themselves quite as much at home in the jungle as the more highly educated Indians. A Burman is seldom without a dah and can use it, and

most of them have a fair practical knowledge of trees and timber. Burman subordinates have their limitations, but I am convinced that they are quite capable, under proper supervision, of carrying out the more simple forest works.

With regard to girdling, it is necessary strictly to observe the girdling limit, and therefore it is necessary to be able to measure a tree properly, a matter not quite so simple in practice as would appear, but I do not think much real sylvicultural skill is necessary. In most divisions there are now several trained subordinates thoroughly qualified for this work, and most of us could give examples of untrained subordinates perfectly competent to do girdlings. There seems therefore no necessity to incur the expense of recruiting additional gazetted officers for this work.

With regard to improvement fellings this, I think, does not require any sylvicultural skill at all, but only common sense. Most Burman subordinates know without being told that teak, when suppressed, is liable to be killed, or its growth retarded and quality affected, and I am confident that any average beat officer could carry out the work without difficulty. On a march I have often discussed the question of improvement fellings with beat officers, and when I have asked them to point out what trees ought to come out, have generally found that they have very quickly grasped what is required. It is not often that forest guards are allowed an opportunity of proving their capabilities, but the two or three improvement fellings I have seen done by forest guards have been well done. The work is often paid for by piece work, and on one occasion where a large gang of coolies was engaged, I was much struck by the fact that even the coolies know exactly what should be done, and in every case were waiting for the marking officer near trees which were suppressing teak and would have to be removed. My main reason however for thinking the work might be entrusted to beat officers is that it would be almost impossible to cause serious injury by bad work. Only bamboos and worthless species would be cut back, and although the cover might be opened out too much by a stupid subordinate, yet generally the more the worthless species are cut back the

better. On the other hand too little might be done, but the probabilities are that the work would be useful so far as it went, and the area could be gone over a second time.

It is, I think, only to be expected that at first there would be some difficulty in getting a scheme, such as proposed, into good running order. But when subordinates were accustomed to carry out improvement fellings annually over several compartments they would, I think, soon become proficient, and they could be gently stimulated by weeding out the incompetents.

If subordinates are not competent to carry out the simpler kinds of forest work it is difficult to understand why they are employed. At present they are employed mainly on hunting for forest offences, and sometimes the whole year's bag does not average more than half a petty offence committed through ignorance. Many reserves are, moreover, to a great extent naturally protected by their remoteness, and there is therefore no reason why subordinates should not be employed to a greater extent on true forest work. I have pointed out that in a division of about 600 square miles of teak reserves there are some fifty subordinates. Even if only 19 of these could be deputed for this work, and for only four months in the year, it would suffice to carry out the programme suggested, and therefore if it can be assumed that beat officers could be entrusted with this work, it is evident that there are sufficient numbers to carry out the work.

The principal duty of a ranger with regard to this work would be to disburse pay to the coolies, and with five rangers in a division this should present no difficulty. Gazetted officers would have to make constant inspections in order to keep subordinates up to the mark, but this should not be impossible even with only two gazetted officers in a division. It is possible to go over 1,000 acres in a day for inspection purposes, and to get a fair idea of how the work has been done, but even if an inspection took two days this would only mean that each gazetted officer would have to spend 38 days on inspection. Much time would be spent merely in travelling, but a gazetted officer has constantly to go round his charge for other reasons, and could combine this with other

work. In many cases also several compartments would be close together.

With such a programme I think possibly the greatest difficulty would prove to be labour. In the district nearly every Burman is a cultivator and if he has no land he cuts a taungya. This usually suffices for his requirements which are not many, and there are few or no coolies who depend for their livelihood entirely on daily hire. The cultivators have plenty of spare time, but they have little inclination to do strenuous and monotonous cooly work in the forest, and to risk being laid low with fever. Improvement fellings are however usually done by piece work by which an average cooly can earn about Rs. 2 a day, and the rates of pay are generally high enough to attract sufficient men. I do not think, however, that local men could be induced to do such work for two or three months at a stretch, and possibly if the work were done on a large scale it would be necessary to import men from the poorer parts of the dry zone or from India. There has however not been any difficulty in obtaining sufficient labour hitherto, and possibly an increasing supply would be forthcoming without the difficulty I anticipate.

At the same time any means by which the labour could be reduced would greatly facilitate the work. Some years ago a letter appeared in the *Indian Forester* describing a method adopted by an ingenious timber trader to kill padauk trees. So far as I remember the padauk was killed by driving in pegs of cutch. Licenses were not issued for green padauk and therefore the trader found it profitable to kill a number of the best trees in the most accessible and convenient situations, and then to apply for a license for ' naturally dead " trees. If a Burman can make such a discovery, there would seem some hope that an Imperial Forest Chemist who has the accumulated knowledge of centuries at his disposal, and has access to a well stocked laboratory, might be able to discover some cheap but powerful drug which would kill the trees we wish to remove, by simple injection. It is hard work felling, or even girdling, some of the large unreserved trees which are found suppressing teak, and coolies would greatly

prefer to go round killing them with a bucket full of drugs and an auger.

The most suitable time to make improvement fellings is, I think, immediately extraction has been completed. The felling of the girdled trees opens out the canopy to some extent, and the elephants break down the bamboos and disturb the soil often with results beneficial to regeneration. It would be a simple matter to prepare a scheme of improvement fellings on a rotation of ten years. It could be ascertained from the working-plans in what year extraction would be completed in each compartment, and a list could be prepared prescribing that improvement fellings should be carried out in that year and also in the tenth and twentieth year before and after.

It is difficult to bring a somewhat elaborate scheme of works suddenly into force, and therefore I think it would be desirable to indicate which compartments should be attended to first. For instance, I think it more important to carry out improvement fellings in those compartments where extraction has just been completed and in the tenth year afterwards, than at other time. I think also those compartments which contain a large quantity of teak repay attention more than those in which teak is sparsely scattered. The working-plans give the growing stock in each compartment and compartments can be arranged in quality classes according to the number of trees per hundred acres. A skeleton map coloured to show these quality classes would be a help in arranging the work. In most working circles it is found that there are many compartments in which there is no little teak that it is not worth while going over them. If it is necessary to reduce the work still more I think seedlings, which are generally numerous and of less value, should be neglected in order that larger numbers of saplings and middle-aged trees might be freed.

I have attempted to show that even with the present establishment improvement fellings could be carried out on a larger scale. It is possible that I have underestimated the difficulties. But if it is true that the staff is inadequate, let us calculate what area it is necessary to take in hand annually, and exactly what staff is

required, and if we can show clearly that an increase of staff is absolutely necessary, let us apply for it. If we can satisfy ourselves that an expenditure of Rs. 5,00,000 cannot be controlled by a staff costing less than Rs. 30,00,000 we ought to be able to make out a sufficiently strong case to convince others. There may be some difference of opinion as to what are the most useful works for our purpose. We are however experts in forestry and are quite capable of determining the comparative value of different works. It is inevitable that there should be a great decrease in outturn at the end of the first or second period of the existing plans when the surplus has been entirely removed, and in order not to dislocate the market we must counteract this decrease by work of improvement. Let us therefore determine what sylvicultural works are required, and calculate to what extent they should be carried out. We have to remember that the Forest Department was specially created in order to ensure the maintenance of the supply of teak, and that if we fail to keep up the supply, we shall be convicted of incompetence.

## BAMBOO PULP AS THE PAPER MATERIAL OF THE FUTURE.

BY HARRY VINCENT.

That bamboo pulp is the one material that is likely to come to the front as a main source of paper stock supply, is the opinion of the *World's Paper Trade Review* of London (February 24th, 1911). The difficulty heretofore has been in the bleaching, as the colouring matter could not be eliminated except by the expensive caustic soda process. This has now been obviated. The great advantage that bamboo has over other pulp material is in the growing. A piece of land once established in bamboo can be cut over annually for an indefinite period, as given a favourably watered situation, and preferably a gravelly soil, the bamboo in the tropics grows to an altitude of thirty feet or more yearly. As it requires but a three-year period to establish a field, it is perfectly plain that neither wood nor any other material can compete with it. As the United States has control over large territories in Porto Rico and the Panama Zone most suitable for bamboo cultivation (which is extremely simple) there should be no difficulty in getting a permanent future supply up to millions of tons a year.

The advantages of bamboo as a pulp-maker are: (1) it has a good, strong vegetable fibre; (2) it is in general easily accessible for water transport; (3) it is cheap and easily collected; (4) it is available in large quantities and abundant within a given area; (5)

it is available for a regular and constant supply, and not subject to violent fluctuations either in quality or price; (6) it admits of simple and ready treatment, mechanical, chemical, or both, for easy and inexpensive conversion into bleached pulp; (7) land established in bamboo, which will take three years from first planting to reach a height of thirty to forty feet, can then be reaped annually for an indefinite period.

Ordinary thick-walled bamboo, which, when given suitable soil and climate, grows with amazing rapidity and yields annually at least forty tons to the acre, contains fifty per cent of a very strong, yet fine and flexible fibre, easily digested by the ordinary bi-sulphite process, and by a new method simply and inexpensively bleached, yielding when properly treated an excellent pulp, felting readily, and producing a paper, pliant, resistant and opaque, of enduring colour, thicker than other paper of the same weight, and forming one of the very finest of materials for writing and printing, and of exceptional value for engraving.

The oldest bamboo is thoroughly and completely digested, knots and all, by the ordinary bi-sulphite process; but care must be taken in the cooking, as there is no reason to suppose that all bamboos are alike. Pine, spruce, and poplar are treated quite differently in cooking, and nearly every factory has its own formula, and different strengths and temperatures are used. Direct steam should never be used with bamboo, but always steam coils with not more than forty pounds pressure until the last two hours, after first liberating the gases derived from bamboo which are different from those of wood. The mechanical portion which is absolutely essential to this process is a preparation of the bamboo for cooking as well as for bleaching. After being selected and assorted the bamboo has to be crushed in exactly the same manner as sugarcane, when it will appear after removal of the sap somewhat similar to mogass, almost pulverised and a slightly damp, spongy mass. In this form the bamboo is extremely permeable by the cooking solution, which can be used comparatively weak and without any necessity for a high pressure of steam. In all cases a solution to be used with bamboo should be as nearly

neutral as possible. It may be slightly alkaline or slightly acid, but excess in either direction will waste a large amount of the fine fibres, and acts adversely on the chemical constituents of bamboo. These fine fibres are, according to Wildridge and Ekman, of great value in forming a close, opaque sheet of paper. They represent about a third of the cellulose, and unless the necessary precautions are adopted, they will be lost in the strainers and washers. So, obviously no part of the preparatory treatment can be carried out away from the place of growth of the bamboo.

The bleaching process is entirely new and differs from any other used for making pulps. It consists in an intermediate process the object of which is to prepare the pulp for bleaching, by steeping the bamboo after it has been cooked for a few hours in a solution made from electrolysed sea-water, salt, and diluted sulphuric acid, then after drawing off the solution (which can be used over and over again), giving the pulp a further bath in a very weak alkali and thoroughly washing it when the whole colouring matter comes away, and a clean, fine and strong, light-colored pulp is left, which is now more easily bleached than any other pulp now in use. No other ingredients are necessary than those specified, which are of the cheapest possible description, and only a light electric current is required. The whole expense of the intermediate process will not add, including the bleaching, more than S 4 per ton to the cost of the pulp. Both the process and the apparatus for producing the solution (which makes use of a novel process in electrolysis) are patented, and there is no other known means of fully bleaching matured bamboo, except the antediluvian Chinese method of "retting."

Under intelligent administration of tropical labour, especially under the farming system, which is so successful a feature of the sugarcane industry in some of the West Indian islands, the raw material should not cost more than $2 per long cord (approximately a ton), delivered at the mill, and the total cost per ton of pulp at a factory turning out 1,000 tons per month should not exceed 30 for a high-grade bleached pulp, worth, at an extremely modest estimate, 50.

To epitomise, the bamboo is the cheapest of all materials; the bi-sulphite is the cheapest of all chemical processes, and the new method of bleaching is much cheaper than any other method in present use.

[NOTE.—The search for paper-pulp material to meet the great and growing demand is of the greatest interest. The increasing scarcity and cost of spruce has already led to successful experiments with other woods, formerly disregarded, but experimenters are continually looking for material which can be grown more rapidly than trees. The foregoing article suggests a possible promising source of supply, but it must be remembered that bamboo is a tropical product and that our mills, representing an enormous investment, are in he North. The utilisation of bamboo on a large commercial scale would involve a considerable readjustment of the pulp industry, and the solving of many questions, among which that of labour would not be the least. It can, therefore, hardly be regarded as a possibility of the immediate future, although well worth consideration in connection with an ultimate supply.—EDITOR.]—[*American Forestry.*]

## TREES AND MOISTURE.

### A GREAT EXPERIMENT.

In order to determine the actual effect of forests on the flow of the great waterways of the country, one of the most important and far-reaching experiments ever undertaken is being carried on in the United States. Experiments are being made on the crest of the Rocky Mountains at the head-waters of the Rio Grande in Colorado to settle beyond all further question the effect of trees in conserving moisture.

Minute observations (says the *Philadelphia Record*) will be made, winter and summer, until the average conditions in the heavily forested area at the Rio Grande head-waters are established beyond doubt. Then that portion of the watershed will be denuded of all timber, and not less minute observations will be taken of the conditions that obtain after the trees have been removed.

The experiments will no doubt extend over an indefinite number of years. Those who have undertaken the work will not stop until they consider that there is nothing more to be ascertained on the subject. The Government has established an experiment

station at Wagon Wheel Gap, well toward the head-waters of the Rio Grande. Both watersheds are being covered and the flow of the streams toward the Atlantic and Pacific are noted. The area included in the experiment ranges from a trifle over 9,000 feet to nearly 11,500 feet in altitude, and is situated in the Rio Grande National Forest.

This site was selected after all the Colorado National Forests on the Continental Divide had been thoroughly examined and comparisons had been made. Dams and weirs have been put in and the water is being accurately measured under all conditions, winter and summer. Each watershed carries a small stream of a permanent character, common to the upper slopes of the Rocky Mountains. The streams will be measured until a distinct relation between them has been established.

By a large number of meteorological observations for a number of seasons, it will be possible to average the general conditions and establish the regimen of such streams. The Government Weather Bureau is co-operating with the forestry service in the observation of conditions at Wagon Wheel Gap.

### DIFFICULTIES OF THE WORK.

A continuous automatic record of rainfall is kept at various points on both watersheds. The amount of snow falling upon different parts of the area included in the experiment must be recorded faithfully, and accounted for by melting or evaporation.

The air temperatures, which affect the melting of the snow and ice and cause evaporation from the soil and from the surface of streams, must be continuously and accurately recorded and the humidity of the air obtained at the same time. The temperature of the soil on the slopes must be taken, affecting as it does the melting of snowbanks in the spring. In short, every day of every year must be classified as regards the factors which might affect stream flow.

No matter how severe the weather, the Government force of experts is out at Wagon Wheel Gap, measuring streams, making

notes on snowfalls and temperature, and contributing a new chapter to the interesting story which is being unrolled by science. The streams at this altitude are icy cold even in midsummer, but in winter their temperature is nearly unbearable. Nevertheless the water observers have to don their wading boots and stand in the middle of each rushing stream, with delicately adjusted recording instruments at their ears, until they have measured the velocity of the water.

Then careful measurement of the height of the stream must be taken, the observer still standing almost hip-deep in the icy stream. In severe storms the difficulties attending the measurement of snowfall are sometimes great. Often it is necessary for the experts to visit the snow stations on snow-shoes, and similar difficulty is encountered in visiting the meteorological stations where weather conditions are recorded.

CONSTRUCTION OF STORM WEIRS.

One of the most interesting features of the work is the operation of the weir method of control by which the stream regimen is secured. The instrument is a stage register actuated by a float, within a still well which is located in the centre of a basin above the weir. The instrument gives a continuous graphic record of the water height by the revolution of a drum which is actuated by a float, and by the movement of a pen, actuated by clockwork, across the record sheet.

The weirs are so constructed that they may be easily regulated for all stages of water. A storm weir has been installed at each dam to care for high floods. To prevent the loss of water through underground seepage concrete dykes have been put in, which catch all the subflow. These dykes open into a settling basin for the purpose of setting the water and catching the débris carried on the stream at flood time. This will give an accurate idea of the silt carried by each stream in flood time. The deposit of silt in the settling basin is measured from day to day, thus giving a correct idea of the amount of foreign material carried by such streams under all conditions.

The rainfall is measured at the foot of each watershed, and at a common point near the heads of the two sheds, making three automatic measurements. Besides the automatic registering rain-gauges there are two ordinary 8 in. gauges on each watershed. For measuring the snow, 16 snow scales have been installed. The depth at each is measured after each snowfall and the water equivalent to the snow on the ground is obtained by taking representative samples. Soil temperatures which are highly important are taken to depth of six inches and are obtained by electric resistance thermometers which are read each day.—[*Literary Digest.*]

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## MYRABOLANS.

It was a happy thought which struck a Calcutta merchant—a shipper of myrabolans—of removing the husk from the stones, and, as a saving on freight, exporting the former only as a better tanning product than the entire fruit. It was questioned whether the stones which formed more than half the weight of the fruit could be rejected. The analyses at the Indian Museum show the superior tanning value of the husk, and the worthless quality of the stones. Two kinds of myrabolans were tested :—

| | | Extract. | Tannin. |
|---|---|---|---|
| Raipur myrabolan, husk | ... | 65·0 | 45·8 |
| Do. stones | ... | 6·1 | 3·7 |
| Singhbhum myrabolan, husk | ... | 59·8 | 44·6 |
| Do. stones | ... | 7·0 | 4·8 |

* * * * *

This discovery will lead to large economic results as regards this export commodity. Myrabolans are used for dyeing and tanning purposes. Last year India exported 73,355 tons of those nuts. Had the worthless stones been extracted and only the valuable husks been shipped, there would have been a saving of half the freight ; 36,000 tons of stones being kept on this side. Perhaps these myrabolan stones may yet be found to be of some use, as there is no such thing as waste, but these are evidently of little value for tanning purposes.—[*Capital.*]

## LONGEVITY OF SEEDS.

An important contribution to our knowledge of the longevity of seeds and the structure of the seed-coat is published by Miss Bertha Rees in the proceedings of the Royal Society of Victoria 23, II, p. 393. In an earlier paper Professor Ewart divided seeds into three classes :—

*Microbiotic* seeds which do not live for more than 3 years.

*Mesobiotic* seeds which last from 3 to 15 years.

*Macrobiotic* seeds which may be able to germinate from 15 to 100 years.

All the hard seeds are included in the last class. These seeds do not swell when soaked in water. They are more abundant in a dry climate than a wet one and seeds of the same species may vary in hardness according to the climate in which they are grown. Plants with hard seeds are most abundant among the *Leguminosæ*, but occur in other orders. The hardness of the seed is due in most cases to the presence of an outer membrane or cuticle, but in Canna seed the ends of the outer layer of long cells (palisade cells) are hardened and there is no true cuticle. This cuticle is believed to be formed by the deposition of particles of wax or fat in the cell walls. This prevents the introduction of water.

In order to let the water into the seed and so start the germination, several methods can be used. The most practical way is to scratch or remove the outer cuticle. If this is broken through at any one point, water will enter and spread to all parts of the seed, so that a single scratch that penetrates the cuticle is sufficient to render a seed permeable. This scratching is done with a file in the case of large seeds, or in smaller ones by shaking them up with sand or passing them through revolving cylinders lined with cement in which sand is imbedded. Another method is to treat the seeds with some strong corrosive agent such as concentrated sulphuric acid, which, if the treatment is prolonged sufficiently, will completely remove the cuticle.

The second method is to remove the waxy substances from the cuticle by certain chemicals known as fat-solvents, such solvents are chloroform, ether or hot alcohol. This method is, however

not practicable, owing to the expense of the solvents and the length of time required to dissolve the wax, usually from three to four months. The principle of soaking hard seeds in hot water to make them swell may be explained in the following way: the effect of the heat is to melt the particles of wax which are distributed through the wall. When they are melted they will tend to run together to form larger isolated drops, and in this way spaces will be left through which the molecules of water can push their way into the seed, causing it to swell and germinate.

In the long list of seed that germinated or failed to germinate after a long period of years the Acacias and Albizzias stand out as very long lived. *Acacia acinacea* after 40 years gave 55 per cent. germination. *A. decurrens* after 16 years on immersion in acid for 8½ hours gave 100 per cent., and *Albizzia lophantha* after 23 years all germinated.

The time required for the action of sulphuric acid at 12-15° C. to produce the swelling of the seed due to the permeation of water varied with different seeds. In *Albizzia lophantha* it required 40 hours at 20° C., or 7 hours at 30 °C. Indigo seed (*Indigofera arrecta*) required 15 to 30 minutes.

The long duration of seeds in the ground only germinating when the ground has been cleared and burnt over, is well known to many persons. Ground is cleared and burnt over and plants which had not previously been seen perhaps for very many years suddenly reappear, the seeds having remained quiescent in the ground till the heat of the sun or of fire has started them into germination.—[*Agricultural Bulletin of the Straits and F.M.S.*]

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## TWO REMARKABLE MONKEY STORIES.

A correspondent in the Akyab district in a place called Maungdaw is responsible for two very remarkable monkey stories in the following language:—These stories are vouched for by the township magistrate here who was an eye-witness himself, in one case at least. Last season threshing was in full swing on a plot of land near the forest and operations there were watched by a

number of monkeys from the neighbouring trees. Now you know, or probably you don't know, the rice is threshed just as Adam used to do it, *i.e.*, by driving oxen round and round over the stuff laid on the threshing-floor, a small boy or girl following the oxen with a stick. Well, at half time work was suspended, and those engaged went away and were enjoying their midday nap when some one came and woke them up and told them to go quickly to the threshing-floor. On arriving there this is what they saw. Some dozen or more monkeys holding the oxen yoke and being driven round and round by a grave faced old grand-papa of a monkey who held a stick in his hand. The whole village, including the township magistrate, turned out and watched the fun until the monkeys taking alarm bolted into the forest. This may seem a big one, but it is vouched for by many people who claim to have seen it. The other story goes that not far from Maungdaw along the seashore is a cemetery. There had been quite a number of deaths in this place, and on the morning in question no less than three funerals. Now an old woman was out that way tending cattle when she was seized by a crowd of monkeys and thrown down, and the monkeys then started to pile sand on top of her. A boy hearing her cries went up, and on seeing what was going on ran to the village with the news. A party answered his call, and on arriving on the scene drove off the monkeys and found the old woman almost buried under more than a foot of sand, all except her head. This also sounds pretty tall, but there are numbers of people to be found here who claim to have seen it, so I send it for what it is worth.—[*Rangoon Gazette.*]

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## SOME TIGER YARNS.

I shall never forget how crest-fallen and foolish a party of us looked on an occasion when we went to view a dead tiger whose death had been encompassed by the poisoning of one of his kills. On one of the party giving it a prod in the stomach, a sound was emitted from its jaws, which to our startled fancies appeared like a roar, and a stampede resulted. After making considerable

progress, we were attracted by the shout and loud laughter of a native in the direction of the dead animal, and on turning round to look, wasn't it gall and worm-wood to see the native positively rolling with laughter at our ridiculous position. His merriment subsiding, he came up and explained that poking the wind-distended stomach of the tiger had caused the wind to rush out of the mouth and give rise to the sound which had so frightened us. Truly we felt as if we could wish the ground would open and swallow us up.

Here is something illustrative of the coolness and daring of the native *shikari*. Of course there are exceptions to every rule. A great sportsman was brought by some natives to a cave which they said was in the occupation of a tiger, tigress and cubs. He was accompanied by two *shikaris*, who passed for men of great prowess in all the region round about. On investigation there proved to be only two cubs in the cave, the parent beasts having probably gone on a foraging excursion. Mr. S. offered a reward to anyone of the peasant people, who would go in and bring out the cubs, just to test the stuff they were made of. Not one of them would make the attempt, although the two *shikaris* exhausted all their powers of persuasion on them. These latter had been indulging in such "tall" talk that Mr. S. thought he would just try them, and turning to them, he proposed that one of them should go in and bring out the cubs. Not a bit of it: neither would move. There was some superstition, or something, which prevented them touching the live cubs of animals they hunted, and so forth. Mr. S., who was anxious to secure the cubs, thereupon went in himself, and bringing them out took up his position on the roof of the cave to await the return of the parent beasts. The tigress soon afterwards came on the scene, and seeing what had occurred and knowing instinctively that Mr. S. was the offender made a spring at him, but he bowled her over with his rifle. The male, which returned soon after this, was killed in the same way.

I heard of a most amusing incident last year. A black panther had killed a bullock on an estate. Two young planters sat up

over the kill. After waiting some time, a black object approached the kill which in the uncertain light afforded by a young moon, through the shady trees appeared to their inexperienced eyes to be the panther. They fired simultaneously, bowling over what afterwards they were disgusted to find was a black pariah dog! Of course they were mercilessly chaffed over the affair.

I was once in charge of a place near where there was a *swami* or god tiger. He wasn't himself considered a god, but appeared to be a domestic pet of a god whose abode was in a sort of a cave at the summit of the hill above the estate. This god was ministered to by a Brahmin whose services were paid for by a considerate Government by large grants of land rent-free. The cave was too sacred a spot to be polluted by the approach of Europeans, but I managed to get a view of it. It was of quartz, and one portion of the rock was concave to such an extent as to form a perfect shelter from sun or rain. Against this another stone rested, so as to form a Gothic arch. The scene was rendered more attractive and charming by a spring which gurgled out from under the floor of the cave.

The tiger was not at home when I went there. I never saw it, but have heard of it. Several coolies on the place had, however, seen it. Once my "boy," when I was absent, said he heard a noise like a cat purring behind the bungalow, only very much louder. Getting up cautiously, he peered through the glass panes of the back door, and was paralysed to find a tiger stretched at full length on the ground outside, gazing in at the door, evidently attracted by the light on the table, which it could make nothing of. I may mention that the "bungalow" consisted of a thatched shanty balancing itself on the top of a hill, and this added considerably to the sense of insecurity felt by the poor "boy." But it was a sense of relief to him to find that the tiger did not prove aggressive. As morning dawned it stretched itself and walked leisurely away. Several attempts were made by planters and others to shoot the beast, but without success. According to the Brahmin priest it bore a charmed life. He averred that a party of native *shikaris* had fired two hundred bullets at it once, none

of which took effect! It never struck him that this might be due to defective marksmanship on the part of the *shikaris.* We never suffered the loss of any cattle from the tiger, and this was an additional proof that he was a *swami* tiger; as, like a good Hindu, he eschewed beef. But I knew him once make a meal off a writer's pony.—[*Old Fogy in Indian Planters' Gazette.*]

VOLUME XXXVII NUMBER 12

# INDIAN FORESTER

*DECEMBER, 1911.*

## FOREST RESEARCH IN INDIA.

## II.

In our last issue we endeavoured to trace the history of, and the work done at, the Forest Research Institute, Dehra Dun, since its inception in 1906.

Let us now pass on to a question which perhaps affects the Department as a whole more closely than any other, namely, the share which officers throughout the service should take in research work, and how the utility of the Research Institute may be extended in the interests of Forest Officers generally. In this connection we may begin by quoting a passage from the Hon'ble Member's speech at the Board of Forestry in 1910: "The next point is the co-operation of the Forest Department, as a whole, in the work of the Research Institute. There is some reason to fear that the Research Institute has not hitherto enjoyed the full appreciation and confidence of the Department in the work which it is carrying out. Demands for assistance and information made by Research Officers on local Officers already fully occupied, are sometimes looked on as an irksome addition to existing duties. But they

are unavoidable if the Institute is to fulfil its purpose. The Institute must always be to a considerable extent dependent on local Officers for information and support. Too much stress can hardly be laid on the importance of research work and on its influence on the treatment by Forest Officers of the important estates committed to their charge, and on the development of those estates on correct, scientific and practical lines. I look confidently to the Forest Board, drawn as it is from all provinces and likely to have so much influence in the management of the Institute, to secure the whole-hearted support of the Department for the work that is being done at Dehra, and to give the officers employed there useful guidance as to the most suitable and most practical field in which to employ their energies." The question was further discussed by the Board of Forestry, who recorded their opinion that local Officers should be encouraged to carry out investigations, preferably in consultation with Research Officers, partly in order to prevent duplication of work and partly because, to quote the Board's words, "much of the information collected locally in the past cannot be utilized owing to the great differences in the manner of carrying out investigations and experiments." The Board also strongly recommended that local Officers be encouraged to continue original work on the lines adopted at the Research Institute, not only in the subjects of investigation by Research Officers but in other subjects of importance locally.

In the more special subjects, like Chemistry, few opportunities occur for local work, while our Botanists and Zoologists are limited in number. Good work, however, has been done in the past by Forest Officers, both in Botany and in Zoology, and those who have a bent for these subjects will find that they can derive considerable assistance from the libraries and museums of the Research Institute, as well as from the Research Officers themselves. The need for local floras has often been emphasized, and possibly in many cases Officers have been deterred from compiling them through lack of knowledge as to how to commence and how to proceed, while the absence of reference collections and literature may have also acted as a deterrent. The extensive Botanical

Library and Herbarium of the Research Institute, together with the advice which the Forest Botanist is in a position to give, should smooth the way for the compilation of local floras by Forest Officers, who could doubtless be placed on special duty during the rainy season for a visit to Dehra Dun in order to work up their material.

We have purposely kept till last the question of Sylvicultural research, which must always be nearest to the heart of the true forester. Our Botanists and Zoologists may be limited in number, but no Forest Officer would care to repudiate the fact that the essence of his calling is Sylviculture, or that every Forest Officer is to a greater or less extent a Research Officer in that subject. And yet, considering the amount of good work actually done in this branch, it is surprising to find how little the Department as a whole has benefited by local investigations, and how few of these are carried to a definite conclusion, partly owing to the repeated transfers of Officers and consequent lack of continuity, and partly owing to an entire absence of system in recording results. Our administrative and executive work is governed by a Forest Code ; when, therefore, a transfer of Officers takes place, the whole fabric of the office does not tumble to pieces, the work being moulded on well-established lines. Yet in nine cases out of ten any Sylvicultural investigations at once fall to the ground in a similar eventuality. Surely something is wanted to prevent this lamentable waste of time and labour and to ensure the proper continuance of experimental work. In the case of statistical information, such as sample-plot measurements, the difficulty is provided for to some extent by forwarding annual or periodic measurements to the Sylviculturist's Office for record and subsequent compilation if found suitable. Officers might well consider the advisability of publishing the results of their investigations even though they may appear to be only of local interest. Some excellent contributions to Forest literature from the pens of local Officers have already appeared in the series of publications of the Forest Research Institute, and we should gladly welcome any additional contributions of the kind. Where investigations or

observations are too incomplete or fragmentary for publication, they might usefully be sent to Dehra Dun for record till required: much useful information of the kind has already been contributed from different localities, and it all helps to increase the value of the tabulated Sylvicultural records which are at the disposal of every member of the Department. We have mentioned that Botanists and Zoologists might derive assistance by a visit to Dehra Dun, and we would add that those who wish to investigate Sylvicultural problems may also find a visit to the Sylvicultural branch of the Research Institute of benefit. They will there be able to ascertain what has already been done in the subject to be investigated, and will also be able to acquaint themselves with the methods followed there in Sylvicultural investigations.

When the new Research Institute buildings are completed, and the museums and laboratories are in order, we are strongly of opinion that selected Officers should be deputed for short terms to the Institute in order to study one or more of the subjects dealt with at it. If this is not done, then the utility of the Research Institute to the Department at large will be greatly discounted, for the progress of work and thought cannot be communicated entirely by publications. The recruit from home comes out well equipped with European methods of Forestry which, as a general pattern to be guided by, are most useful; but unless he has an opportunity of extending his knowledge towards what is known of Indian conditions and methods, he may during his service waste much time in acquiring what might be learned in a short time at Dehra Dun. In this way the Research Institute will be to the Forest Service what the Staff College is to the Army, and we venture to think that the results will be highly beneficial.

There is one more important matter to which we must refer, and that is, the question of Provincial Research. These are the days of decentralization, and naturally the decentralization of Forest Research work may well be considered along with that of administrative work: we would indeed go so far as to say that in the case of some branches decentralized research is a necessity, for although experimental work on a fairly wide scale can be carried

out at or near Dehra Dun, this centre does not represent every climatic condition, and hence local experimental stations, in charge of responsible Officers, are necessary to supplement the work done at Dehra Dun. But whether local research of this kind is done by executive Officers in the course of their ordinary duties, or by Officers on special duty, we are strongly of opinion that in the interests of efficiency and economy these Officers should be in close touch with the Central Research Institute at Dehra Dun and should make use of that Institute. The idea is sometimes mooted that Provincial Research Institutes, each with its complete staff, should be established in different parts of the country, but it is quite clear that those who make such suggestions can have no conception of the expenditure involved. It may be mentioned that the Research Institute at Dehra Dun has in some ways been specially fortunate in already having the museums, library and herbarium of the Forest College to start with. New representative collections of the kind would have cost a great deal of time, money and labour to acquire, and without them the Institute would have lost most of its value. It is for this reason difficult, if not impossible, to estimate the original cost of equipment of the Forest Research Institute, particularly as the value of museum collections can hardly be estimated in money. Apart from the value of these collections with Herbarium and Library, and apart from the value of existing buildings, the capital amount which will have been spent on the Forest Research Institute up to the time the new buildings are completed and equipped, will probably be well over two lakhs of rupees. In addition to this, when the full staff of the Institute has been sanctioned, the annual cost of its maintenance, including all charges, will probably amount to over $1\frac{1}{2}$ lakhs of rupees. We cannot guarantee the strict accuracy of these figures, which are merely estimates of the roughest description, but as far as we can foresee they may be taken as something roughly approximate. Now if the Research Institute is not to be made full use of by the Department at large, it is obvious that this expenditure can hardly be justified. But, apart from the question of economy, in the interests of efficiency alone it is highly important

that the work of local research officers should be co-ordinated with the scheme and methods of work as carried out at Dehra Dun. We have already pointed out how individual efforts in local research have in the majority of cases in the past led to no definite result, and it is with a view to definite results being attained that we advise the co-ordination of local work with that of the Centra Research Institute. Local research stations are advisable and necessary, but fully equipped Provincial Research Institutes are not. In this connection we are of opinion that much useful research work could be done at the different local Forest Schools, and in Provinces possessing them these schools might form the natural centres of local forest research.

So far as research work has gone in the past, judging by completed results, we as a Department cannot altogether rebut the charge of lethargy, though it must be admitted that the mitigating circumstances are strong; but with the increased facilities now at our disposal, we should have every inducement in the future to remove the stigma which lay on us during the fifty years in which Indian forest research lay dormant except for the brilliant and conspicuous efforts of a few individuals.

## SYLVICULTURE IN BURMA.

### PART IV.*

A review of sylviculture in Burma would be incomplete without taking into account Mr. Troup's revolutionary proposal to introduce an entirely new system of working. His project is the extremely ambitious one of converting our natural tropical forests into a very fair imitation of a Prussian Forest in the short space of one rotation. There is a dash and a spirit of enterprise about his proposals which command my respectful admiration, but I am still more impressed by the fact that, although the scheme bristles with difficulties, yet after a visit to Burma of only a few days, he was able to dispel our doubts and to gain a favourable and even enthusiastic acceptance of his views. The latest reference appears

* Mr. Troup's reply to this article will be found in the Correspondence columns of this issue.—HON. EDITOR.

to be that not only the Tharrawaddy forests, but all forests, for which henceforward working-plans may be required, are to be treated in accordance with his views.

Let us consider what is meant by the "selection" system and why it should be necessary to change the system. The name is, I think, misleading. We naturally do not "select" immature trees, or trees of worthless species which it would not pay to extract, but we are obliged to go round our forests periodically and to take whatever we can get. It would, I think, give a clearer idea merely to state that an uneven-aged wood is objectionable, and that it is desirable to re-arrange the stock in blocks of even-aged growth.

The reasons why he justifies the change are :—

(*a*) in order to retain fire-protection ;

(*b*) in order to make it profitable to extract species other than teak by means of roads and tramways ;

(*c*) in order to reduce the time and cost of supervision.

With regard to the first reason, Mr. Troup creates the impression that the selection system is responsible for defective reproduction. His own article in the March number of the *Indian Forester*, 1905, however, proves that it is fire-protection, and fire-protection only, which prevents natural reproduction of teak. He is well aware that many areas worked on the selection system are not fire-protected, and if he refers to statistics collected for working-plan purposes before fire-protection was introduced, he can satisfy himself that in every case there was ample reproduction. The real truth is that, as he himself has proved, if we retain the selection system we cannot retain fire-protection. The simpler plan would be to discontinue fire-protection, but the alternative he proposes is to make ourselves entirely independent of true natural reproduction ; and by these means to avoid the principal objection to fire-protection, while reaping all the advantages. A change of system is, however, an elaborate and complicated matter, and if he thinks the advantages of fire-protection are sufficient to justify the change, it is reasonable to ask him what they are. He has no right to take up the position that the advantages are

"undoubted" except by one eccentric individual whose opinions are of no consequence. I would refer him to page 371 of the *Indian Forester* for 1904 where he will find that one of the most senior and experienced Forest Officers in the province has doubts on this point, and if he has kept in touch with opinions in Burma he will know that information on this point is badly wanted.

From his second reason, it is evident that, not content with changing our system of management, he wishes to revolutionize our methods of transport and extraction. He suggests that, provided a great quantity of material could be exploited simultaneously, it would pay to make roads and tramways. If he referred to the forest survey sheets which give contours of ten feet, he would quickly discover that it would be quite impracticable to make export roads in most teak forests. Even if it were possible, it is inconceivable that transport by land should be as cheap as by water. The Tharrawaddy forests are exceptionally close to the market, but transport by land would mean carting at least 12 miles by road, and carriage by rail for about fifty miles, and if he has experienced the difficulty and cost of carting logs averaging a ton and sometimes weighing as much as 5 tons, and calculates the cost of freight by rail, he must realize that it must always be cheaper to drag logs to the nearest floating stream. Unless, however, he succeeds in revolutionizing our methods of transport, the concentration of the material to be exploited is not altogether an advantage. He would have, I suppose, some 20,000 trees per square mile to be extracted simultaneously, but each log would have to be dragged separately, and therefore there would be no reduction in cost owing to the quantity extracted. The great number of logs would be a difficulty in the smaller streams. A great number of elephants and cattle would have to be concentrated into the area which would become foul, and this would inevitably mean disease.

There are a few reserves, however, where the natural method of transport is by road or tramway. Such reserves are generally close to the railway or densely populated areas where there is a strong demand, even for inferior kinds of timber. The area of

such forests is also very limited in extent. It is therefore practicable and desirable in such cases to utilize every acre to the utmost advantage, and as there is reason to believe that the outturn per acre, especially in a tropical forest is very much greater when the crop is even-aged, I think Mr. Troup's uniform method, or a system of clear felling combined with reproduction with *taungya* crops, is clearly indicated. The conditions, however, are totally different from those in the extensive and remote teak forests on the hills to which Mr. Troup confined his suggestions.

The third reason he gives is that the uniform system would reduce the time and cost of supervision. So far as I understand his proposals, there will be little saving effected until 150 years hence. At present some of our divisions are unwieldy and much time is spent merely in travelling. Fifty years ago, however, the present Tharrawaddy Division would have seemed ridiculously small, and in the next 150 years it is not improbable that with the improvement of communications and the further splitting up of divisions the present difficulties would disappear. In the meantime we shall have to go over our forests periodically in thirty years so that "adequate inspection of the fellings" will continue to be difficult. He apparently regards fire-protection as an essential part of his scheme, and proposes to extend it to the whole division, and therefore we shall still have to go round to inspect the fire-lines. He would, however, make concentrated regeneration fellings instead of scattered improvement fellings, but the saving is discounted by the fact that, as he pointed out, we fail to carry out our programmes. Personally I do not think it would be an unmixed blessing to be cooped up in an obscure corner of one's division. When the work is distributed to some extent, one gets to know one's division properly, and what with forest offences to be enquired into on the spot, and subordinates' work to be inspected, there is usually plenty to do. The distribution of the work is however, as pointed out by Mr. Leete, almost entirely a matter of arrangement. Apparently in Pyinmana the fellings under ten different working-plans based on the selection system, are concentrated under a single girdling scheme. If it commends itself there

is no reason why this principle should not be carried still further. The body of a working-plan report usually consists of useless padding, and it is seldom necessary on tour to refer to the appendices. A Divisional Officer could, with very little trouble, prepare a summary of all the plans in his division, and as the prescriptions are very elastic he could concentrate or distribute work as he pleased. It would seem fairer to attribute the scattered nature of the work to the idiosyncracies of working-plans or Divisional Officers rather than to the inherent defects of the selection system, but Mr. Troup in his anxiety for concentration has introduced features which will eventually, I think, cause serious inconvenience. He held charge of the Tharrawaddy Division when it was double the present size and included the Zigôn Division, and I have no doubt the present division seems to him quite small and compact. He proposes one plan for the whole division. But it is inevitable that during the next 150 years or in the following centuries, the division will have to be again split up. Mr. Troup maintains that his proposals will reduce the work, but experience in other countries proves that even-aged woods require so much attention that the average size of a division has been reduced to about 25 square miles. When once we have committed ourselves to the uniform system and complete concentration of work, it is difficult to understand how a division could be split up. It would be absurd to make two divisions, the one containing even-aged woods from one to seventy-five years and the other woods ranging from seventy-six to 150 years. In the one there would be no fellings and no revenue. He seems, therefore, to obtain concentration of work only by sacrificing elasticity.

In order to get a clear idea of the comparative merits of the "selection" system and "uniform" system, it is necessary to determine what the yield would be, and what amount of work would be involved, in either case. As, however, Mr. Troup has proved that fire-protection cannot be continued under the selection system, I will omit this work, but will include improvement fellings carried out on a ten years' rotation to please myself. The teak-bearing area of the Tharrawaddy Division is about 240 square

miles. As Mr. Troup does not propose to make fresh enumerations he will have to base his calculations on the following statistics which were collected about thirty years ago. As, however, no estimate was given of the number of fifth class trees in one reserve, an estimate has been included based on the proportion of fourth and fifth class trees in the other working circles :—

| Girth class. | Girth. | Corresponding age. | Number of sound, green teak trees. |
|---|---|---|---|
| II ... | 6′—7′ | 117—150 | 77,417 |
| III ... | 4½′—6′ | 79—117 | 169,017 |
| IV ... | 3′—4½′ | 51—79 | 352,857 |
| V ... | 0′—3′ | 0—51 | 1,065,530 |
| | | | 1,664,821 |

With a little juggling with figures, the following table is obtained which gives a clearer idea of the trees available for future periods :—

| Age. | Number of sound, green teak trees. |
|---|---|
| 120—150 | 70,379 |
| 90—120 | 127,134 |
| 60—90 | 288,359 |
| 30—60 | 392,983 |
| 0—30 | 785,966 |
| | 1,664,821 |

As the enumerations were made thirty years ago all the trees ranging from 120 to 150 years of age will have attained maturity,

but at the same time they will have suffered to some extent from mortality. In either case there will be a yield, for the first period of probably about 60,000 trees. In the following yields, however, the difference in the two methods will become apparent. Mr. Troup must, I think, admit that naturally grown teak suffers enormous destruction from the suppression of inferior species, and that this could be almost entirely avoided—at any rate so far as saplings and large trees are concerned—by systematic improvement fellings on a ten years' rotation. Ignoring the fact that the rate of growth would be increased and assuming that all the mortality could not be removed, the following would seem to be a modest estimate of the outturn to the end of the first rotation, under the selection system :—

| | |
|---|---|
| First yield ... ... ... | 60,000 |
| Second do. ... ... ... | 100,000 |
| Third do. ... ... ... | 200,000 |
| Fourth do. ... ... ... | 300,000 |
| Fifth do. ... ... ... | *Nil.* |

The last yield appears peculiar, but it is based on Mr. Troup's researches in these very Tharrawaddy forests, which prove that the youngest age gradation has been wiped out by fire-protection. It is a matter which may cause unpleasantness with our successors, but Mr. Troup and myself are not responsible for this and have clear consciences.

Comparing the outturn that will be obtained from the "uniform" system, we are given to understand that in each period a sub-periodic block of one-fifth of the area will be regenerated, all the existing crop being removed to make way for even-aged woods ranging from one to thirty years. This area will, therefore, be unproductive for the next 150 years. At the end of two periods two-fifths of the area will have been rendered unproductive, etc. Meantime girdling will only be carried out over the remaining area. At the same time, as he admits that it is impracticable to carry out improvement fellings even on a thirty years' rotation and is discontinuing them in favour of his regeneration fellings, the struggle for existence will be unrestricted in the remaining natural

forest, and therefore owing to the great mortality the yield will only be at the rate of about 60,000 for the whole area.

The yields until the end of the rotation would therefore be :—

| | | | | | |
|---|---|---|---|---|---|
| First yield | ... | | 60,000 | = | 60,000 |
| Second ,, | ... | $\frac{4}{5}\times$ | 60,000 | = | 48,000 |
| Third ,, | ... | $\frac{3}{5}\times$ | 60,000 | = | 36,000 |
| Fourth ,, | ... | $\frac{2}{5}\times$ | 60,000 | = | 24,000 |
| Fifth ,, | ... | $\frac{1}{5}\times$ | *Nil.* | = | *Nil.* |

Mr. Troup's system, therefore, has the advantage of reducing the labour and cost of extraction, but reduces the revenue.

With regard to the amount of work involved under the selection system, it would be possible to concentrate the work, but personally I think it would be preferable to retain the five independent working circles and to combine them under a summary. My own inclination would be to distribute the work to some extent. The system of extraction is by means of petty native contractors, and it might lead to confusion and trouble if all the fellings were concentrated into one block. The tendency, especially in a division like Tharrawaddy, must be to entrust more and more work to subordinates, and therefore, I think, it would be a disadvantage to have all work concentrated into one beat or range. However, the plan could be made sufficiently elastic to give the Divisional Officer a free hand.

The amount of girdling would be the same in both cases at first, but would eventually be much greater under the selection system. The division is well staffed with rangers, sub-rangers and school-trained subordinates, but if the staff is insufficient one could, as the work is revenue-producing, rely on getting an increase of staff. It is rather the sylvicultural works which have to be compared. Under the selection system, improvement fellings on a ten years' rotation would have to be carried out annually over 24 square miles. Although the area to be gone over may be large, yet the average number of teak trees per acre of all sizes is only eleven, and of these many would require no assistance. The amount of work involved, therefore, would not be great. I estimate that fifteen subordinates for two months in the year would be ample, and as there are fifty-eight beat officers apart from sub-rangers, etc.,

this ought not to strain the resources of the division. The cost would amount to about Rs. 15,360.

Mr. Troup, however, would only make his regeneration fellings over an area of 5 square miles. Under the selection system the improvement fellings could, if necessary, be consolidated into one block, but although it is claimed that the uniform system would bring about concentration, yet it is evident that work would be going on in three different centres, and except in the first period work would be carried on in two different sub-periodic blocks. As I have pointed out improvement fellings would only entail freeing eleven trees per acre, and actual experience has shown that one cooly can complete an acre a day. Regeneration fellings are an unknown work, and therefore no statistics are available. The growth per acre in a Burma forest, however, appears to be about sixteen trees other than teak over 3 feet in girth, and 2,000 stems of bamboos. This growth would have to be entirely removed to make room for the new even-aged reproduction, and in addition the bamboo would have to be cut back twice at intervals of eight years in order to bring the young trees out of the reach of the bamboo. At a modest estimate an acre could not be completed with less than ten coolies, or ten times as many as are required for improvement fellings. On this basis, while he is carrying out his 5 square miles of regeneration fellings, it would be possible to complete 50 square miles of improvement fellings, or more than double the area considered necessary. This ignores dibblings, etc., but if he intends to wound the soil he would require an army. He appears to take into greater consideration the time spent on supervision. Improvement fellings are simple and the work could probably be done satisfactorily by subordinates, and it would only be necessary for the work to be inspected by a gazetted officer. Mr. Troup's regeneration fellings, however, require very great skill, and there is not the least doubt that the whole work would have to be carried out under the direct supervision of gazetted officers. The present staff would certainly be insufficient. If he was successful in obtaining his even-aged woods, thinnings would certainly be necessary. Experience in other countries prove, that

even-aged woods have to be thinned out once in ten years, and eventually this work would be distributed throughout the division and his "concentration" of work would be a myth.

It is evident that Mr. Troup realizes that fire-protection is not only unnecessary, but disadvantageous under the selection system. As he claims, however, that the first and principal object of his proposals is "to secure the undoubted advantages that result from fire-protection," it is evident that with the uniform system he proposes to extend fire-protection to the whole division except in the areas under regeneration. He is well aware, however, that fire-protection involves constant supervision and that the work cannot be concentrated.

It may be interesting to enquire whether Mr. Troup's works are likely to be successful. The works he proposes are regeneration fellings assisted by—

(*a*) dibblings,

(*b*) wounding the soil and sowing,

(*c*) planting,

(*d*) concentrating the grazing of elephants in bamboo areas,

(*e*) burning where necessary.

With regard to regeneration fellings, a deserted *taungya* is an instance of clear felling with regeneration from adjacent woods, but the *ponzo* growth which springs up is not encouraging. I understand, however, that Mr. Troup intends to thin out the overwood, cut out the bamboos, and burn over. A former Chief Conservator of Forests has, I believe, had experiments carried out exactly on these lines in most divisions in Burma. As I have not had access to the reports and have been on leave, I cannot be sure of the results, but believe they were disappointing. Most of us could make a satisfactory regeneration felling in a European forest, but, in Burma, bamboos are a difficulty and in many ways the habits of the trees are different, and although I endeavour to keep in touch with current knowledge, yet, so far as I know, there is no reason to believe that any even-aged reproduction as required by Mr. Troup has ever been obtained, or could be obtained without further knowledge. Mr. Troup, however, is a member of the

Imperial Bureau of Research and can make any enquiry he wishes, and therefore has probably gone into the matter. We have heard in Burma rumours of great ledgers in which sylvicultural notes from all parts of India have been steadily accumulating for the last five or six years. But if he has solved the difficulty, he should enlighten us. If he has not done so, his proposals are premature.

When, however, it comes to the question of dibblings, we are on surer ground, as this is a matter which Mr. Troup has gone into personally. If we refer to the *Indian Forester* for October 1905, we find that he stated, with an emphasis which shocked the older generation, that "in the vast majority of cases complete failure has resulted." He went further and stated that "so far it appears that our somewhat costly *taungya* system is the only one on which we can place reliance." In the discussion he could not be induced to modify his views, and has never given any reason to show that he has changed his views subsequently. We may therefore, I think, assume that he intends to create a large area of plantations each year. He will make us look rather foolish, as after mature and careful consideration we had decided to have nothing more to do with plantations. We would endure this cheerfully, however, but we have realized that plantations involve an enormous amount of work. The thinnings alone towards the end of the rotation when there will be a complete series up to 150 years make one thankful that by that time one will have retired on pension.

His aim is to get a mixed even-aged crop "in which teak forms a higher proportion than it does at present." In Europe where the formation of even-aged woods has been brought to a high degree of excellence, it is seldom that more than two species are grown together, and only when they are known to combine well together. If he can imagine an even-aged wood of yew, elm, oak, birch, larch, spruce, beech, silver fir and alder, he would still, as the variety of species and differences of growth are greater in Burma, have an inadequate idea of the results he would obtain. The growth may be even-aged, but will not be uniform.

It may be interesting to compare the two systems in a more general manner. We know that our forests are stocked with species in exact proportion to their suitability to the locality, but as many of these are worthless, the object of both methods is to increase the value of our forests by increasing the proportion of valuable species. At present in most forests teak is the only marketable species. Its reproduction is naturally sporadic. It is seldom that we get more than two or three seedlings per annum per acre, but this reproduction goes on steadily from year to year, and in the aggregate is of great value, and it is in fact entirely from such reproduction that we are deriving our present revenue of some Rs. 90,00,000. With the selection system the whole of this can be utilized. There is nothing to prevent our adopting measures to assist such reproduction, but for the present we can content ourselves with the fact that there is already on the ground an ample supply of teak of all stages to give us, if we protect it to maturity, a rapidly increasing yield. We are very ignorant of the requirements of the different species, but with the selection system and improvement fellings there is no danger of waste of energy in promoting the spread of species unsuited to the locality, as no species could be assisted unless growing naturally which would be a proof that it was suited to the locality.

With the uniform system the principal feature is that, as it would spoil the symmetry of the even-aged woods, the whole of our natural reproduction, of the value of the present worth of Rs. 90,00,000 at 150 years' discount, must be sacrificed. As our areas are extensive, staff small and funds limited, the time does not seem propitious for sacrifice, but the scheme is more far-reaching and aims at establishing profuse reproduction at rare intervals in a manner contrary to nature by unknown and with untried methods. There will therefore be a great risk of establishing species unsuited to the locality and unlikely to flourish.

With the selection system and improvement fellings it is only necessary to destroy inferior species where interfering with more valuable species. Such work is known to be useful. There is therefore no waste of energy and no sacrifice, even of inferior

timber, unless justified. With the uniform system, however immature teak would have to be sacrificed. At present large sized timber yielding Europe squares is preferred, and small timber is at a discount. The whole crop of inferior species would also have to be removed to give place to a new crop of the same species. At present in most localities inferior species are unmarketable so that the fellings would be unprofitable, but it is probable that were they to be left, many of these would attain in a few years sufficient value to justify extraction.

Under the selection system the yield must steadily and rapidly increase, but under the proposed uniform system the *yield will steadily dwindle down to nothing, and then suddenly* reach a limit beyond the dreams of avarice and remain stationary. As it is proposed to treat all our forests in accordance with Mr. Troup's views, let us consider what the result will be in the last year of the rotation. Felling will only be possible in $\frac{1}{150}$ part of our reserves which will consist of neglected jungle in which nothing has been done to improve the stock. The remainder will consist of even-aged woods ranging from one to 149 years of age from which no yield can be obtained until the following year. Our export trade will gradually have disappeared and some other substitute found for teak. The timber firms will have given up business. For the local demand inferior species will not even be available as they also would be suffering from the uniform system, and we should have to suffer the indignity of getting our timber from India. It would be little satisfaction to know that in the following year endless supplies would be available, as by that time the market would be so dislocated that the supplies could not be handled and absorbed. It is probable that our expenditure will steadily increase and therefore towards the end of the rotation, instead of a respectable surplus, we shall be faced with an enormous deficit.

In conclusion, I would suggest that Mr. Troup's system is more naturally suited to the Sal forests of the United Provinces than for the teak *forests of Burma. We are under moral obligations* to supply teak to the Navy, and have vast interests dependent

on us, and cannot afford to take great risks in the interests of pure Forest Science. We have also more to lose by sacrificing the great natural wealth of our forest resources and the United Provinces has more to gain by renovating their forests by artificial methods.

The Imperial Bureau of Research has announced that it is impossible to attend to our little problems in connection with teak, and have decided to concentrate their energies on Sal. This would be excellent opportunity to utilize the knowledge accumulated.

In only one year, Mr. Troup's year, have students had the option of avoiding Burma,* whereas the United Provinces acknowledge that they have got the cream of the Imperial Forest Service.

If, however, Mr. Troup is obdurate, I would ask him whether he could not spare us one small working circle, if only to demonstrate the folly of the "selection" system.

H. C. WALKER,
*Deputy Conservator of Forests.*

ARAKAN DIVISION, BURMA.

## METHOD OF RE-AFFORESTING THE PLAIN AREAS OF BLACK COTTON SOIL IN THE BELLARY DISTRICT.

There are two ways of working black soil. One is sowing on mounds and the other sowing in furrows made by iron ploughs and levelled with a heavy *guntika*.

1. *Preparation of mounds*.—In my range I tried sowings on mounds 12′ × 4′ × 1½′ each in rows 9′ apart. The seeds sown were chiefly Babul, Nim (*Melia indica*), *Albizzia Lebbek*, and Tamarind.

*Melia indica*, Babul and Tamarind germinated well over 95 per cent of the mounds and have grown from 9″ to 1½′ before the winter. During the winter and summer the mounds were found

* We presume the writer means " . . . . have students *not* had the option of avoiding Burma."—HON. EDITOR.

to crack. Steps were taken to fill up the cracks with earth dug from the trenches around the mounds. Several of the seedlings were found dead before the ensuing rainy season. Those that escaped the drought of the first summer are growing well and the greatest height attained by seedlings in one year was Nim 4½′, Babul 3′, Tamarind 1′. The results of this operation show 50 per cent of the mounds successful. The cost of carrying out mound sowings was Rs. 7-2-0 per acre as per details shown below:—

| | Rs. | a. | p. |
|---|---|---|---|
| Preparing 180 mounds per acre, at 6 pies per mound ... ... ... | 5 | 10 | 0 |
| Sowing seeds, per acre ... ... | 0 | 8 | 0 |
| Filling in the cracks, per acre ... ... | 1 | 0 | 0 |
| Total ... | 7 | 2 | 0 |

2. *The second method.*—Last year I tried the second method of sowing seeds. I had iron ploughing over 154 acres in four different reserves. The method employed is shown below. In order to eradicate *mirth* grass I engaged iron ploughs drawn by five pairs of good oxen or six pairs if the animals were weak, and had the land well ploughed and then exposed for one month.

I then got the ploughed area levelled with heavy *guntikas* and had the *mirth* grass collected and burnt. In the rains of June and July 129 acres of land so treated were sown with seed drills in furrows 6′ apart. Tamarind, *Melia indica* and Babul germinated densely over 36 acres. Elsewhere the growth was poor.

In January 1911 while inspecting Badnahal Reserve I found big cracks all along the furrows and saw the danger of the roots of the seedlings being exposed. To prevent the seedlings from dying I at once had both sides of the furrows levelled with an ordinary *guntika* drawn by a pair of oxen and employed women coolies to add the loosened earth to the seedlings forming a ridge along the furrows. This process successfully closed all cracks. Once again I had the sides loosened with *guntikas* to prevent the surface cracking during the summer. The seedlings were in January 6″

to 9" high. In March I found they had grown from 1' to 2' high; and on further inspection on the 25th August I found they had attained a height varying from 2' to 5'.

There are not less than 1,500 seedlings per acre over 36 acres and 500 seedlings per acre over 9 acres in this reserve.

The cost of the operations was Rs. 13 per acre. Details are given below:—

| | Rs. | a. | p. |
|---|---|---|---|
| Clearing shrubs and grubbing out stumps ... | 1 | 0 | 0 |
| Iron ploughing ... ... .. | 6 | 0 | 0 |
| Levelling with heavy *guntika* ... ... | 3 | 0 | 0 |
| Sowing with seed drills ... ... | 0 | 8 | 0 |
| Loosening the soil with ordinary *guntika* and adding loosened earth ... ... | 2 | 0 | 0 |
| Collection of seeds, etc. ... ... | 0 | 8 | 0 |
| Total ... | 13 | 0 | 0 |

In 15 acres of land ploughed with iron ploughs seeds were sown broadcast as an experiment. The results, however, are very poor, seedlings being very few in number and unequally distributed over the area.

The above operations have been carried on in Adoni Range, Bellary District, where the annual rainfall is 22 inches.

ADONI:
30*th August* 1911.

S. THUMBOO NAIDU,
*Forest Ranger.*

## GROWTH OF *HARDWICKIA BINATA* SEEDLINGS.

In coupe I of W. C. VI, Rayachooty Reserve of Adoni Range, Bellary District, Madras Presidency, 155 acres were ploughed in the rains of 1906 and sown with seed drills. Among the various kinds of seeds sown were mixed those of *Hardwickia binata*. While inspecting this area in 1908 I found that one of these seedlings (*Hardwickia binata*) had produced a leading shoot 5′ high and 4″ in girth. Again on inspection on 6th August 1911

out of his sleep by a terrific explosion and at the instant saw a blaze of light through his closed eyelids and smelt sulphurous fumes which pervaded his bed-room for some time after. On collecting his thoughts he realised that his house had been struck by lightning and his room partially wrecked. From subsequent observations it appears that the discharge took place at the left hand (south) end of the roof, the finial being broken. The main current then went through a tiny hole half an inch or so in diameter in the shingle roof along a rafter for 4 or 5 feet to one of the main posts—this post (girth about 4 feet) passed along the planked wall of the bed-room and was within 6 feet of the bed on which Mr. Bell was lying. The upper end of the post does not appear to have been much damaged but the portion in the bed-room was quite shattered. Several splinters had flown out striking and damaging the wall and furniture, one huge splinter was hurled over the mosquito net against a large mirror at the other end of the room and projected it bodily out of the open window at which it was placed smashing it into fragments. The portion of the post near the ground was uninjured. A wire fence happened to be nailed under the house on to the line of posts of which the struck post was one and the current went along this wire and tore small splinters off several of the posts with which the wire was in contact.

The marvel is that Mr. Bell was untouched and is none the worse for his rude awakening. He is to be congratulated on his escape.

PYINMANA:
*1st September* 1911.

W. H. CRADDOCK.

## AN INDIAN FOREST OFFICER'S VIEWS ON BRITISH COLUMBIA.

Mr. A. E. Lowrie, Deputy Conservator of Forests in the Central Provinces, has recently returned from British Columbia, where he spent his leave in looking round to ascertain if the country held out sufficient inducements for settling there after retirement

from Government service. Mr. Lowrie's conclusions will interest many, and we quote in full from a letter written by him on the subject in the *Pioneer* of 13th September 1911 :—

"I have just returned from a most interesting and instructive trip to British Columbia and am most thankful to good friends who advised me to go and see before I settled on anything. To one and all contemplating settling in British Columbia I would give the advice, go and see before you settle on a purchase. It can easily be done on three months' leave *viâ* Liverpool and Montreal, and is not an expensive journey. The money is well spent, and will, I am sure, save many a one from cursing his luck. Before I started on my voyage of discovery, I had read volumes of literature on the subject and seen all the gorgeous pictures of the fruit grown and also of the beautiful landscapes, all very true in some cases and during the summer months. But never a picture of winter scenery. Why? You can only get the real state of the climate from the old timers, men who have grown up with the country, and even these are diffident to talk and can only very gradually be drawn out. I should be inclined to call the climate very tricky and not always to be depended on. Judging also from the opportunities I had in talking to people on the spot, I should say that fruit growing is likewise not always to be depended on; and decidedly not what a number of people think, put down the plant, water it, and after five years get the glorious fruit one sees in the pictures, and make your fortune. Then again as regards small fruit, the answer I got when I broached the subject was, 'Be careful. What are you going to do when the strawberries are ripe, and no labour to pick them?' I know of a case where a man, his wife and youngster went in for picking strawberries, because they could not get the labour and the fruit was ripe. This on the top of the hard household work quite knocked them up; so that the next year he did without strawberry growing. I had fully made up my mind to forego much, but alas, much too much is demanded. What I greatly objected to was the labour difficulty. Here no doubt it may be diplomatic to keep the wages as high as they are, in order to draw the immigrants to colonise the thousands of square miles of country.

In his letter in the *Pioneer* Mr. Redmayne talks about some Anglo-Indians having lately taken Sikh servants with them. I wonder on what pay? I met no end of Punjabis in the place who were very glad to see me and I them, and we had long discussions on the country and things in general. Now none of these men were drawing less than 45 dollars a month; taking Rs. 3 to a dollar, this brought the wages up to Rs. 135 a month. Your Chinaman labourer also gets this, with food found, but I fail to see why the wages should be so high when the men told me that they managed very well on less than 50 cents a day all told. I say none of the men were drawing less than 45 dollars a month, while the greater majority of them were drawing two and a half dollars a day. One's own friends will never say no to the place. They want you, they want society. I was much amused at a real estate agent (by the by out of every ten men one meets eight are such or have a tendency to real-estatism) who told me that the land had gone up 50 per cent at a certain place. I went to see because a General had lately settled there; needless to say, I fought shy of the place. I would again say, go and see and find out from those really uninterested in buying and selling you land, of whom you will meet a few. It is a great country in many ways and you will agree with me in saying you were glad at having gone and seen it."

## THE FORESTS OF THE EMPIRE.

The increasing interest taken in most civilised countries in questions of forest conservation is a notable proof of the growth of wisdom in the utilisation of the world's resources. For centuries mankind was prone to regard forests mainly as arenas for wholesale and often wanton destruction. The forests were, as the Siberian peasants still say, "the gift of God," to be used or wasted without let or hindrance. Their effect upon rainfall and temperature, their value in preventing the denudation of soil, the large part they play in the control of rivers and the preservation of moisture were factors either not understood or disregarded. Happily most Governments are now recognising that forests are valuable assets, both by reason of the revenue they produce and the direct and indirect

benefits they confer. The steady growth of checks upon the reckless exploitation of forests is a wholesome sign. Germany led the way in scientific forestry, and her splendid woodlands, now a possession of enormous value, have been to a large extent under State control for a hundred years. Austria-Hungary has long realised the importance of her forests to agriculture, particularly in the Alpine provinces, and has developed an efficient forestry system. France has not only carried out large works of afforestation on waste lands, but has exemplified the close interdependence of forest and water-supply in the official title of her Forest Department. The vast forests of Russia are slowly coming under scientific control. In the centre and south of Russia stringent measures of regulation have been introduced, though the huge timber areas in the north are still almost without State care. In Southern Siberia the process of forest extermination is now largely supervised, and in Central Asia the very special value of the mountain forests as "preservers and distributors of rain" receives constant official attention. Norway and Sweden have both begun to appreciate the fact that their valuable forests are not meant solely for destruction. The United States, already consuming three times as much timber as the country annually produces, is turning with enthusiasm to problems of practical forestry. It is curious, and not a little regrettable, that, while so much activity is visible in other lands, the forests of the British Empire have hitherto received comparatively scant scientific treatment at the hands of the State. The one shining exception is India, where an admirable Forest Department is doing excellent work. Canada is still chiefly engrossed in production, and gives little serious attention to the restocking of cleared areas, although her productivity must inevitably diminish in time. Australia has not only failed to realise the immense importance of forest conservation, but in some quarters at the Antipodes the question is even regarded as a matter of little account. In the United Kingdom the influence of forests on rainfall and water-supply is fortunately a negligible issue, but the economic advantages of schemes of afforestation are only now arousing the belated interest of the authorities.

Even in India the earlier administrators only drifted into tentative measures of forest control almost by accident. It was the possibility of using teak as an alternative for oak in the construction of warships which first led to attempts to supervise the output of the forests. That the forests of India had any direct relation with water-supply or with areas under agricultural cultivation was almost unperceived. Even to-day in India the scientific aspects of forestry are only fully recognised by very few experts. In an admirable paper by Mr. Eardley-Wilmot, late Inspector-General of Forests in India, recently read before the Royal Society of Arts, it was pointed out that the report of the Irrigation Commission takes absolutely no notice of the relation of forests to the subject under inquiry. That is an extraordinary omission, which reveals the perils of over-specialisation. Practically one-fourth of the Indian Empire is under forest, though all land labelled "forest reserve" is not necessarily covered with timber. The forests are useful for the protection of catchment areas, the maintenance of perennial streams, and the storing of moisture, and so have a very direct connection with irrigation. Yet the Irrigation Commission sinned in good company, for it is on record that at one time the Government of India actually tried to sell outright the forests of the Central Provinces. In Mr. Eardley-Wilmot's opinion, the day may still come when the Central Provinces forests may be as valuable as those of Burma. The real father of Indian forestry was the late Sir Dietrich Brandis, and under the policy he initiated the Indian Forest Department has, in spite of some shortcomings, done much solid work. It came into an almost ruined inheritance, for from the time of the Aryan invasion down to the final Musalman irruption the forests of India had been neglected and laid waste. Large tracts of country in India are out of cultivation to-day owing to the ruthless destruction of trees in bygone years; but though the Forest Department has to rely almost entirely on the natural reproduction of the forests, and can therefore never hope to repair much of the evil wrought in the past, it has effectually wiped out the reproach of neglect.

So far as England is concerned, the modest grant assigned by Mr. Lloyd George for experiments in afforestation is one of the few features of the Budget which arouses little contention. The gigantic progressive outlay recommended by the Royal Commission on afforestation cannot be contemplated without careful preliminary investigation. For the backward condition of Canada in regard to scientific forestry there is much reasonable excuse. The rainfall and water-supply of Canada are not seriously affected, and the vast areas under timber have possibly justified a somewhat reckless process of clearance, which cannot, however, continue indefinitely except under scientific direction. The successful *inauguration of a large pulp and paper-making industry in New*foundlandhas so far led the island State to realise the value of its forest resources that an important conference is about to meet at St. John's to consider questions of forest conservation. Nova Scotia is now taking the wise preliminary step of preparing an "inventory" of its forest wealth. It is melancholy to have to add that nowhere in the Empire is less practical attention paid to scientific forestry than in Australia, the country of all others where forest administration should be regarded as of the highest importance. The only plea that can be advanced in behalf of the Commonwealth and the State Governments is that they are almost overwhelmed by the many urgent questions simultaneously demanding their attention. Yet the need for a careful consideration of forest problems in Australia is very pressing. The wanton sacrifice of timber in every Australian State will certainly bring retribution if it is not checked. In no country within the Empire is scientific forestry less understood; in no country is a wise forest policy more imperatively required. Mr. Newton Moore, the able Premier of Western Australia, has just arrived in this country to make known the growing attractions of his State as a field for immigration. Mr. Moore no doubt is well aware that the fertility of the new wheat belt which he so justly extols depends to a large extent upon the influence on climate and rainfall of the forests between the wheat belt and the sea. Forest conservation in Western Australia is, however, still in its infancy, as in all the States of

the Commonwealth. The value of plantations, moreover, as a shield for the crops from hot parching winds in certain areas is still disregarded; and most of the smaller Australian townships elect to remain gaunt and unkempt when they might easily be embowered in trees. It is not, however, for æsthetic reasons, but for severely practical purposes, that a closer study of forestry is required in a continent of such uncertain rainfall. The system of "dry farming," so earnestly advocated recently in Australia by Senator McColl, is no doubt worth careful attention in comparatively arid districts; but in Australia, as in India, forestry should find a foremost place in all movements for increasing the productivity of the land.—(*The Times.*)

## DÚB GRASS.

The commonest grass and at the same time the best and most nutritious fodder grass for cattle and horses in India, Ceylon, the United States of America and Australia is one which deserves more than a passing notice. It is called "dúb" in Northern India and "hariali" in Madras and Bombay; it is the "Bermuda grass" of America, and the *Cynodon Dactylon* of botanists. It is abundant everywhere in India, except in the sandy parts of West Punjab and the black cotton soil of Central India. It has been introduced with cultivation by Europeans in many parts of the world. It has been so long known in India that it is regarded as sacred to Vishnu and Ganesha. In the Vedas it is thus addressed: "May Durva which rose from the water of life, which has a hundred roots and a hundred stems, efface a hundred of my sins, and prolong my existence on earth a hundred years." The Hindus believe that a benevolent nymph dwells in the plant, and when they build a house they place the grass on the four corners of the foundations. Durva is also one of eight ingredients of the Arghya, a respectful oblation made to gods and venerable men.

The dúb is a perennial creeping grass flowering all the year round. In winter it appears scanty, at which time it may be said

to be at rest, and a crop of fresh grass will spring up on the first fall of rain. It grows freely on poor soils and waste places where other grasses will not thrive and has a remarkable power of withstanding protracted droughts. It forms long wiry underground stems, and varies in height from about two inches on poor ground to about two feet in good soil. The underground stems make it very difficult to eradicate in places where it has been established. For this reason it should only be grown where it is to remain permanently. It is particularly abundant on roadsides and delights in sandy soil ; it is an excellent sand-binding plant and has no objection to salt.

Dúb grass requires no special method of cultivation and may be grown like an ordinary kharif crop. The ground is well ploughed to level and pulverize the surface soil. The roots or underground stems are cut into portions and sown broadcast and ploughed in by a native plough to cover them with soil. The roots spread considerably before they appear above the surface, which they do evenly and regularly. It then comes up thickly during the rains. The grass should be cut immediately the flower begins to appear ; in this state the juices of the grass are more nutritious, and the hay is far superior than when made from the fully matured plant. Besides, when cut before the seed appears, the plant is more vigorous and produces another crop much sooner. Under ordinary circumstances two days, or at the most three days, should suffice for making the hay. The hay keeps well for more than a year. An experiment was made some years ago in Madras on *three acres of land without irrigation. Five cuttings yielded 8* tons 13 cwt. of hay, which was sold for Rs. 360-13-0. The cost of curing it was only Rs. 105. The grass is brought into the cities in large quantities. Cavalry regiments are supplied by grass farms but usually grass-cutters collect the plant root and leaves, beat and wash out the mud, and sell it to the stables.

Dúb is an excellent species of grass for making lawns. The best lawns in India are said to be in the ornamental gardens in Lucknow where they were laid out many years ago by Mr. Ridley.

Mr. Howard has lately been successful in preparing lawns in the grounds of the Agricultural College at Pusa, and has described a method by which an uneven, unsightly and partly water-logged piece of ground of about ten acres was in less than a year converted into a first-class sward. The surface of the land was first levelled and graded so that there was a gentle slope. The area was then repeatedly ploughed, and at the end of the monsoon a well-aerated and clean surface was obtained. The grass stems were chopped up and mixed into a thick paste with cow-dung spread over the artificially-watered surface and covered with dry grass. The dub soon gained a hold on the ground, and as soon as it began to grow the young grass was frequently cut by lawn-mowers, and removal of troublesome weeds was attended to.

A very thorough investigation has been made into the cultivation and composition of Bermuda grass in America by Messrs. Francis and Baird, who declare it to be the best pasture grass in the Southern States. It will grow on any kind of soil, but will produce the best result in rich soil. It prevents washing of soil, and grows easily in alkaline lands where other crops will not live. The most important part of the investigation was to show that Bermuda hay ranks very high as a cattle food in comparison with other hays. The yield of hay for the first season was 5,850 pounds per acre. The second season was not so favourable, and 1,667 pounds per acre were harvested. The most remarkable fact noted in the tables of analyses is the high amount of nitrogenous matter or protein. This was specially marked in the first year, when the second cutting showed a protein content of 22 per cent.; but there is a gradual decrease towards the end of the season, and the average was 18·17 per cent. Digestion experiments made with Bermuda hay on sheep were satisfactorily conducted. The results showed that the hay was easily and well digested. The most important constituents, fat and protein, were higher than in five other fodders and were excelled only by corn ensilage and lucerne. The report concludes: "When the expense of these foods is considered, it is apparent that Bermuda hay has no equal."—(*Capital.*)

## USE OF TELEPHONE LINES IN FIGHTING FIRES.

In fire fighting a minute may mean millions. To realise the truth of this statement, one has only to inspect a trained fire department, used to guard the lives and property, in any city. Most of us are more or less familiar with their time-saving devices; we have admired the splendid horses taught by months of patient labour, to spring to their places at the sound of the gong; have seen them harnessed to the truck in the time it takes to press a button; observed men drop to their places from the floor above. All this training and expense to save a minute's time in the battle against the fire demon, in a city where man has used his utmost ingenuity to build so as to thwart the ravages of this element.

Compared with such a well organised system, the Forest Service methods seem crude indeed. One man with an axe and shovel guards from one to two hundred thousand acres of timber land, worth from one-half to five million dollars. In the greater part of these forests, nature seems to have invited their destruction by strewing the ground with a carpet of dry leaves and resinous needles, and covering the branches and trunks with moss, that when dry, burns almost as quickly as gun-powder. For one man to attempt, single-handed, to check a conflagration under such circumstances seems worse than foolhardy; and yet, let it be told to the credit of the tribe who wear the Forest Service badge, that when necessity demands, they pit their strength and cunning against the flames, and sometimes, aided by night dews and bull-dog endurance, win out. The Forest Service records could reveal many such cases of which the public has never heard. It is only when the battle has been lost and the fire becomes a public menace that the matter gets into print.

It is obvious that chances are all against conquering a fire of any magnitude under these conditions; consequently, every human endeavour is used to prevent the starting of such conflagrations. During the dry summer months, a ranger's waking hours are spent in patrolling the routes frequented by travellers, to extinguish neglected camp fires, and in searching his district with a field glass

from some look-out point, to detect the first faint column of smoke that means the beginning of a forest fire.

With so much territory to cover, it is a physical impossibility to have all parts of the district under his supervision at all hours of the day. There will come a time when several fires will start at once. The causes are various; sometimes they are set by lightning from the electrical storms that are common in mountainous country; more often they are due to carelessness of campers or tourists; occasionally they are started wantonly by some person who objects to the arm of the law, as represented by the Forest Ranger, reaching back into the wild places; again, it may be that an unextinguished match, or a spark from a pipe or cigarette is dropped in the dry humus, as the hunter or prospector wanders in places remote from the generally travelled trails. The spark ignites the slow burning duff which smoulders, perhaps for days, unseen, the thin smoke being lost in the blue of the spruce tops above it; slowly it burns its way to the resinous roots or mossy trunk of some conifer; the mountain breeze fans it to a flame; it leaps up and seizes upon the dry twigs and the pitch laden foliage; the tree bursts into a pillar of flame and the destruction of the growth of centuries begins. Any of these events may happen any day during the long drought of summer. When they do occur, the ranger needs help and needs it quickly, to save the heritage he has been set to guard.

If he has a telephone, the call for help will be in at head-quarters within an hour, and in another the ranger will be at the fire planning his battle and doing all he can to check the flames. At head-quarters the organisation that has been perfected for just such emergencies is set to work; by telephone the nearest rangers are sent to his aid; from the lists that have been prepared and kept on file of the available men and horses that can be hired at the nearest settlement, crews and supply trains are organised within a few hours and sent in, if additional help is needed.

With no telephone in his district the ranger must ride to the nearest settlement where he gathers such help and supplies as possible, with the least loss of time and returns to the fire after

sending a messenger on to head-quarters with the news. But, in the meantime, hours have been lost that may mean thousands to the nation. I have seen seven million feet of timber burn in one afternoon, because a privately owned telephone line on the national forest was out of repair in just such an emergency as has been described. Several hours were lost in getting a messenger out to the nearest ranger and the news to headquarters; a crew was organised and sent in without loss of time, but arrived four hours after the fire had broken out of control of the ranger and the few men he had gathered. In this short time it swept the whole mountain side clean. The supervisor bought that telephone line before another season opened.

While the principal reason for building these lines is for fire-protection, they pay for themselves in other ways by facilitating the business and administration of the forest. Hardly a week passes but the ranger finds it necessary to communicate with his supervisor upon some matter of business. Mail routes are scarce in these remote districts. To get to head-quarters he may have to ride one hundred miles, or even more. This means several days of labour lost, to say nothing of the risk of leaving the district without any patrol. With a telephone the matter can be settled in fifteen minutes and the ranger does not leave his work.

During the summer months the forests are used to pasture thousands of head of sheep, cattle, and horses, that are trailed for scores of miles to these summer pastures. The telephone is a boon to the owner in enabling him to keep in touch with his foremen and outfit.

This is why the Forest Service spends thousands of dollars of its appropriation each year in the construction of telephone lines. Besides those built and owned by the Service, they have the free use of many miles of telephone built by settlers in co-operation with the Service. Free right of way and poles are granted to any company, corporation, or private party to cross the forests with such lines; in exchange for these privileges the Forest Service asks the right to connect its lines, or to place an instrument where needed. Settlers and miners are glad to have an instrument

placed in their cabins free of charge, the only fee required being that they notify the rangers of any smoke seen in their vicinity. Ofttimes an abandoned telephone line, that has been built into a once prosperous mining camp, is purchased or leased at small expense. Temporary lines are often strung to some lookout point where the instrument is placed in a box and nailed to a tree; such lines are generally strung on trees or brush and taken down when the season is over.

A comprehensive plan for a telephone system has been worked out for each forest; few of these have been completed to date, but something is being added to them each year as appropriations are available. With their completion, and an increased force for patrol during the dry season, a serious forest fire on the national forest will be a rare occurrence.—*(American Forestry.)*

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## CAUSES OF FORMATION OF LATERITE.

It is a familiar geographical fact that in tropical countries the surface is often covered with the red earth called laterite, which forms a thick mantle. Its origin has been the subject of many investigations, and it is now generally accepted that it is simply produced by the decomposition of the underlying rocks, this decomposition taking place under special conditions. In a note in *La Géographie* for April 15 last, M. Paul Lemonie discusses the interesting question as to the exact nature of these conditions, basing his remarks upon his own researches, and upon a recent paper by Mr. J. B. Harrison in the *Geological Magazine* (vol. vii). Mr. Harrison gives reasons for believing that laterite is the product of decomposition, owing to atmospheric agents, of igneous or metamorphic rocks. The question of most geographical interest, however, is why the particular decompositions concerned should only occur in hot and damp countries, to which laterite is generally stated to be limited. The cause usually given is the alternate occurrence of wet and dry seasons in these countries, but Mr Harrison shows that in British Guiana, the country whose red

earths were studied by him, perpetual humidity reigns in the forests where laterite occurs, and that clays, frequent in temperate countries, also occur there as a result of the decomposition of the rocks. The immediate cause of the production of laterite or of clay appears to be the nature of the rock. Rocks with plagioclase felspars and abundant ferro-magnesian minerals give rise to laterite, those containing alkaline felspars give rise to clays.

If this be true, there seems no apparent reason why laterite should not occur in cold countries as well as hot ones. Why then has it never been observed in the former? The explanation is apparently to be found in the tendency of the laterite to become hard. The causation of the hardening process is obscure, but it is probably due to changes in the degree of hydration of the oxides of iron and aluminium, as well as to progressive modification of the alumina and of certain silicates which pass from the soluble colloid condition to the insoluble one. The deposition of hydrates of iron is also a factor. The hardening is sufficient to preserve the laterite in hot countries, but in cold countries the deposits are exposed to the action of frost which pulverises them, and so permits the particles to be carried away as they form. In other words, it is not the heat of tropical countries which permits the formation of deposits of laterite; it is the absence of cold there. If this hypothesis be well founded, then at least minute traces of laterite should be discoverable in cold countries. These should now be sought.

In this connection it is interesting to note that the characteristic desert varnish (*vernis du désert*), found on the grits of desert regions, has been proved to exist also in minute traces on grits elsewhere, notably on those of the Vosges. This varnish is due to the evaporation at the surface of water taken up by the rocks and subsequently exuded, which leaves behind a film of salts as it evaporates. The varnish is not confined to desert regions, but it finds there the conditions necessary for its conservation, and the same may be true of laterite in hot countries.—(*Scottish Geographical Magazine.*)

# EAST AFRICAN GAME AND ITS PRESERVATION.

## THE WEALTH OF GAME.

*(From a Correspondent.)*

In British East Africa the Empire admittedly possesses a country which has hardly a rival in the world for the wealth of big game it contains, and up to the present time this wealth has been little affected by the rapid rise and colonisation of the Protectorate; in fact the one has assisted the other. Many of the prominent settlers originally came out merely to shoot; the numerous sportsmen widely advertise the country, and on the other hand game laws and a careful system of preservation have come into existence. The abundance of game cannot continue indefinitely, but it is positively astounding to-day.

One of the finest game districts is that part of the country which lies to the north-west of Mount Kenia. Here a huge loop is formed by the Guaso Nyiro, a river which takes its rise on the densely-wooded slopes of the great solitary mountain, and after joining the Guaso Nerok circles eastward to lose itself finally in the Lorian Swamp. Within the loop itself the country bears a strong resemblance to the South African veldt while more to the east it becomes arid, red soiled, and rocky. In a single morning in the first of these two divisions it is possible to see, not merely an enormous number of animals, but also a great variety of species. Zebra and the common kinds of antelope, such as the oryx beisa, Grant's gazelle, and Thomson's gazelle, are there in their hundreds; small bunches of the largest of all antelopes, the eland, are met with; jackal slink away across the plain; ostriches are dotted about here and there, and seem to recognise that they are secure from molestation by special ordinance; hyrax or rock-rabbits occupy the stony kopjes; a dik-dik, or little antelope about the size of a hare, is in striking contrast to a rhinoceros, which lies like a fallen log asleep under a bush or stands, a black dot in the distance; and, strangest of all sights, occasional herds of giraffe may be seen among the scrub, moving until disturbed with stately dignity and turning into ungainliness itself when they run;

their long necks seesaw, their tails swing, and their legs seem always in their own way.

In the arid region to the east less game is found, but two species, which are met with in few other places in the world, gerenuk and Grevy's zebra, have their home there. Gerenuk are very shy and graceful antelopes, with unusually slender necks; they are not unlike miniature giraffe, and seem to need little or no water, but browse on trees, resting their forefeet against the trunk, and do not graze. Grevy's zebra is much larger than Burchell's or the common zebra, and more delicately striped. Both these animals are extraordinarily local and in a few miles one's camp is moved beyond their range. Leopards are everywhere, though they are too wary to be often seen, and no one can guarantee the sight of a lion; innumerable instances are on record of the way in which some sportsmen have hunted for months without seeing a single one, and others have run into a band in one of their first days out. It is common enough, too, to follow a herd of elephants for weeks without success. In East Africa they have been hunted so much that they are not often to be caught in the open; unlike the rhinoceros, who has never learnt not to blunder into view at the scent of danger, the elephant has a full appreciation of the power of the modern rifle. At the first intimation of an enemy in the neighbourhood the herd are apt to start on a long, undeviating march covering 30 miles a day till they have reached the safety of the retreat for which they were heading. Most of the hunting has to be done under the most dangerous conditions possible; the sportsman has to follow their trail through a tangle of brushwood or bamboo, which is almost impenetrable to him and yet offers no obstacle to the huge beast he is pursuing; and the African elephant has learnt not only wisdom, but also the desire for revenge. The writer's companion was deliberately hunted in the forests round Meru by a herd of elephants, who suspected his presence, and owed his life solely to the lucky chance of finding in the undergrowth a tree large enough to withstand them.

Of the other dangerous animals many give first place to the buffalo. The menace of the rhinoceros lies only in his vast

stupidity; he is not dangerous except in bush country, when he bursts out suddenly and moves very fast and with uncanny silence. The charge of a leopard is incredibly swift, and he springs from one enemy to another, but unless wounded he will invariably try to slip away. A lion's chief danger is in his unexpectedness; no one can prophesy what he will do; some let themselves be killed without a struggle, but, if a lion charges, death alone will stop him. This last is also true of the buffalo, and the buffalo alone chooses his ground. The elephant and the rhinoceros have only two senses for purposes of defence; their scent and hearing are wonderful, but they are very short-sighted; the buffalo has very keen sight as well. In a herd buffalo will seldom or never charge over standing men, but no beast in the world is more dangerous than a wounded bull. He rounds on his trail and will stand motionless for hours, concealed in a thick place of vantage, with the sure instinct that he will be followed; his cunning is matched only by his immense vitality. A few years ago the herds of buffalo were decimated by the scourge of the rinderpest but now they are increasing again so fast that in Uganda they have been taken off the protected list, and in East Africa two bulls, instead of one, may be shot by the holder of a license.

### MEASURES OF PROTECTION.

All the game is rigidly protected. No one may shoot without a license, of which there are three kinds, the traveller's, the resident's, and the sportsman's. The traveller's is cheap and only allows the killing of a few of the common antelope; the other two are identical, but the sportsman is, justly enough, made to pay far more than the resident. A schedule informs the license-holder of the number of each species he may shoot, and this is varied from time to time under the supervision of the Game Warden. No trophies may be exported without his sanction after a return of the animals killed on a trip has been filled in, so that as close a check as is possible in such a country is placed upon indiscriminate slaughter. To kill an elephant one must not only be a license-holder, but must also take out a special license of £10; to kill a

second, an additional license of £20, though this latter sum is refunded if a second is not killed. Any tusk weighing under 30lbs. is confiscated by the Government, unless good cause is shown to the contrary, a rule which practically protects all cow elephants, whose tusks rarely average above 15lbs. To kill a giraffe a further special license is required, and only one bull of the rarer antelopes, such as the splendid greater kudu, roan, sable, and eland, is allowed. Besides all these restrictions there are two immense game reserves, in which nothing, not even lions and leopards, which rank as vermin, may be shot without a permit, and this is seldom given; and there are also minor reserves for certain animals. The eastern boundary of the Southern Game Reserve, a tract of country about the size of the British Isles, is formed by the line of the Uganda Railway, and travellers can always see the ordinary kinds of antelope grazing in security close to the train, and can sometimes catch a glimpse of a lion or a giraffe.

Such are the measures which are now in force to prevent the decrease of the game, but the interests of game preservation and of colonisation must of necessity prove antagonistic in the end. Lions, for example, were more numerous round Nairobi, which lies by the Southern Game Reserve, last year than in any previous year, and those settlers who have farms in the neighbourhood naturally have a grievance. What has happened in South Africa must one day happen here. The sportsman, if anything, increases the wealth of game; by killing the old bulls, which carry the best heads, he benefits the herds, and the death of a single lion more than counterbalances a host of antelope trophies. It will not be the sportsman but the tide of cultivation which will eventually diminish the game, by rolling it back from the areas of fertility and confining it to the inaccessible and unprofitable regions. This, however, cannot be for many years yet, and though some beasts, such as the rhinoceros, are surely doomed to extinction, it is a comforting thought to all who love the wild life that its present abundance is being watched over and protected in so complete a manner.—(*The Times.*)

## SOME STRANGE ANIMAL PRODUCTS.

As Forest Officers in Burma are aware, the antlers of stags in velvet are highly esteemed by the Chinese for use in medicine, and the high price offered for these immature antlers forms a direct incentive to the slaughter of stags out of season on the part of Burman hunters and unscrupulous persons. In this connection it is interesting to learn that in one part of China at least the "goose with the golden egg" is not killed, according to the following report from the Kansu Province of China, by a writer in the *North China Daily News*:—"In Taochow I saw some strange industries. One was the keeping of large stags as big as a fair-sized horse, reared for the sake of their horns, which are cut off every summer and sold for as much as Tls. 60 for use as medicine. The horn is soft, and the softer it is when removed the higher the price realized. The other was the raising of the Machi, a sort of large pheasant, the tail feathers of which are very valuable, as they are needed for the dress hats of Mandarins."

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## THE NILGIRI GAME ASSOCIATION.

The annual report of the Nilgiri Game Association for the year ending 30th June 1911 is to hand. Game preservation has had good results in the case of ibex on the Kundahs, over 80 head having been counted in the course of a single morning on two occasions; in other localities also herds of smaller numbers have been seen. So far as sambhur are concerned the season is reported to have been one of the worst stalking seasons on record, and frequent complaints have been made regarding the small number of stags with shootable heads, albeit the number of sambhur have in no way diminished. Wild dogs are said to be one of the main causes of interference with stalking, and although 55 of these pests were destroyed during the year their numbers do not appear to have diminished.

The head of game killed during the season has been smaller than for some years past, and with the exception of a fine bison head no remarkable trophies were procured. The bison head in

question had the following measurements—Spread, 41½ inches; largest girth of horn, 18¼ inches; length of horns, 33½ and 30½ inches.

Attempts to introduce chukor and sisi partridges are still in an experimental stage, and it will be interesting to watch the results.

The financial affairs of this most useful Association are in a sound condition. Mr. S. Cox, I.F.S., continued to be Honorary Secretary throughout the season.

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## SOME ANSWERS TO EXAMINATION PAPERS.

The following are some titbits in the shape of answers to examination papers at the Forest College, Dehra Dun, for the genuineness of which we can vouch :—

*Geology.* (1) *Deccan trap* belongs to the crustaceous system of the secondary period.

(2) *Oolite* consists of small granular pieces fixed in a row and giving the appearance of a fish row.

(3) *Oolite* is a limestone formation in the form of a row of fishes and round nodules.

(4) . . . . In this period Mastodon, grandfather of elephants, is found.

*Forest Utilization.—Gutta-percha* is a substance like lac got from an American insect with specific name *Gutta*.

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